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## SOME ASPECTS OF THE TERRITORIAL SYSTEM IN LESSER FLORICAN *SYPHEOTIDES INDICA* (J.F. MILLER)<sup>1</sup>

RAVI SANKARAN<sup>2</sup>  
(With five text-figures)

**Key words:** grassland, conservation, lek, grazing, mating system, agonistic behaviour

The territorial system of the lesser florican *Sypheotides indica* is described. Based on the spacing patterns of males, the species was found to have a promiscuous mating system. The temporal spacing of agonistic interactions and the absence of site fidelity are analyzed. The effects of grazing by domestic livestock in grasslands on territory formation is discussed.

### INTRODUCTION

The lesser florican *Sypheotides indica* is an endangered bustard endemic to the Indian sub-continent (Sankaran *et al.* 1992). It breeds during the south-west monsoon (Jerdon 1864, Ali and Ripley 1969, Dharmakumarsinhji 1950), immigrating into western India at the onset of the monsoons and emigrating in early October (Sankaran 1991, Sankaran *et al.* 1992). This species breeds in grasslands, a habitat that is now fragmented and patchily distributed. The males occupy territories during the breeding season from which they display aerially to attract females (Ridley *et al.* 1985, Sankaran 1991).

Long term conservation strategies for any

species require detailed knowledge of its ecology. To manage the breeding habitat of the lesser florican, it is important to understand the functioning of the territorial system because factors such as spacing patterns, location and size of territories, the effects of livestock grazing on territory formation etc. is crucial in effective conservation strategies. The objective of this paper is to provide baseline information on the territorial system of the lesser florican.

Territories function as : exclusive feeding areas, nesting and/or pairing sites, or both, or 'mobile' territories that individuals exhibit to guard resources that are not spatially fixed (Tinbergen 1957). Correspondingly, the definition of the term territory has varied from 'fixed exclusive area with the presence of defence that keeps out rivals' (Brown and Orians 1970), to a less rigid definition 'whenever individual animals or groups are spaced out

<sup>1</sup>Accepted February 1993.

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more than would be expected from a random occupation of suitable habitats' (Davies 1978).

In this paper, territory is broadly defined as an area guarded against other individuals of the same species (Odum and Kuenzler 1955, Hinde 1956). In the lesser florican, territories are formed only by males and are defended against other males. The primary function of male territory in the lesser florican is for courtship display, this being similar to most species of bustards (Mendelssohn *et al.* 1979, Cramp and Simmons 1980, Downes 1981, Osborne *et al.* 1984, Ridley *et al.* 1985, White 1985, Shulz 1985, Narayan and Rosalind 1988, Rahmani 1989).

#### METHODS AND MATERIALS

**Study areas:** I studied the lesser florican at three grassland sites, Naulakha, Hazariya and Rampura. The principal study site was the Naulakha grassland within the Sailana Kharmor Sanctuary (23° 31' N, 75° 01' E), Ratlam district, western Madhya Pradesh. It comprises of 354 ha. of grassland, crop-field and grazing land. The grassland area (Naulakha) within the sanctuary is about 200 ha. Hazariya, a 90 ha. grassland (c. 3 km away), on the same plateau as Naulakha was regularly monitored. The 2400 ha. Rampura-Movalia-Kalitalai grassland complex (22° 53' N, 74° 19' E), about 8 km from Dohad, in Panchmahal district of eastern Gujarat, was visited once in 1987 and floricans were studied there in 1988 only.

All three study sites fall within the Malwa plateau. The Malwa plateau covers about 34,600 sq. km and is a wide table-land with a mean elevation of 484 metres above sea level; the plateau is undulating and interspersed with a few hilly regions (Raychaudhari *et al.* 1963). The study areas were a series of low gently sloping ridges. Each ridge was from 500 m to 2 or more

km long, 200-500 m wide and less than 50 m high. The valleys between the ridges drain rainwater from the grassland. The terrain was most steeply undulating at Rampura, least so at Naulakha and intermediate at Hazariya. The ridges at Rampura were larger than those at Naulakha or Hazariya.

All three grasslands are protected for the production of hay, the harvest beginning at the end of October.

**Grazing pressures in the study sites:** Amongst protected grasslands three levels of grazing pressures were seen, and one of each type was studied. Most of this study was done in the grassland with the maximum grazing pressure (Naulakha) and the one with no grazing pressure (Rampura). The intermediate type (Hazariya) was monitored.

1. *Naulakha grassland (Partly grazed grassland):* Here, livestock grazing is usually permitted up to five weeks after the onset of the monsoon; cattle thus exploit the first flush of vegetation at which time grazing pressure are heavy (c. 1 animal/hectare). After this the grassland is strictly protected from grazing until the hay harvest is completed in November. Once the harvest is completed, grazing is again permitted in the grassland, livestock thus exploit the residual grass stubble.

2. *Hazariya Grassland (Seasonally grazed grasslands):* In this grassland, grazing is stopped at the onset of the monsoon, and the grassland is protected until the harvest is completed in November. Grazing is then permitted between hay harvest and the subsequent monsoon.

3. *Rampura grassland (Totally protected grassland):* This type is protected from grazing throughout the year. Hay harvest begins at Rampura in November and ends by January.

Grass growth rates and net grass height were less in Naulakha than in Hazariya and Rampura. At Hazariya, grass heights were



between 69% (at the beginning) to 13% (at the end of the monsoon) higher than Naulakha. This narrowing of difference in grass heights may be due to growth compensations (Olson and Richards 1988). At Rampura, due to a total absence of grazing, grass growth rates were the highest and net grass height was twice as much as at Naulakha.

**Study period:** This study consisted of about 475 days of field work over 5 consecutive monsoons between 1985 and 1989.

**Vegetation:** All three study sites were pure grasslands, almost devoid of trees. The few trees present were *Mahua*, *Madhuca indica*, Mango *Mangifera indica*, Peepul *Ficus religiosa* and Phoenix palms. The grasslands were dominated by *Sehima nervosum*-*Chrysopogon fulvus*. Other grasses include species of the genera *Heteropogon*, *Apluda*, *Cymbopogon*, *Aristida*, *Brachiaria*, *Eragrostris*, *Dicanthium*, *Digitaria*, *Setaria*, *Bothriochloa* and *Pseudoanthesterea*. In all three grasslands, *Butea monosperma* is a common bush. At Rampura, like *B. monosperma*, Teak *Tectona grandis* was common, but were stunted and bush like.

**Climate:** The monsoon (June 15 to October 15) usually has 40 to 50 rainy days. Most of the annual precipitation occurs in July and August. Average precipitation (6 years) at Sailana was about 1000 mm but strong inter-annual variations exist (see Shukla 1987). Temperature during the monsoon varies between 17°C and 38°C.

**Methods:** The lesser florican is a difficult bird to study because the vegetation in the habitat hampers free observation. Males are easier to study than females because they are conspicuous and localised within territories; females are cryptically coloured and reclusive.

This study was based primarily on direct observations of unmarked male lesser florican. Attempts were made to colour mark birds, but

these were largely unfruitful. One male was colour marked in 1985, but it abandoned its territory probably because capture was done at the end of the breeding season. Two males that were ringed in 1984, remained within their territories till the end of breeding season (Ali *et al.* 1984).

Detailed observations of florican behaviour were made from vantage points between 50 and 300 m from the focal animal. Camouflaged hides (blinds) were placed near the display sites of selected males. Observations from these were limited due to a narrow field of view, particularly when the grass was tall.

Behavioural observations confirmed to the focal animal sampling method (Altmann 1974), as floricans are solitary during the breeding season and male territories are widely spaced out. Observations followed two principal methods of data collection. In 1985 and 1986, floricans were observed from dawn to noon and from noon to dusk on the following day, thus completing a full daylight period. In 1988, however, observations were made from dawn to 12 noon and resumed at 1400 hours and culminated at dusk. Observations were made for 20 continuous minutes, followed by a ten minute interval. Choice of focal animal varied according to the phase of the territorial period. During the pre-territorial phase, as floricans were not localised focal animals were selected at random. After territory formation, the same territories were studied over consecutive study periods.

During the early part of the breeding season, I scanned the study area every day, to estimate the number of new arrivals. Once territories were established and males became localised, such scanning became less frequent and primarily served the function of monitoring males that were not being studied.

Due to the size of the lesser florican's territory (<2 ha.), a high degree of resolution



was needed to do home range studies. As this was not possible during the study, only overall maps of the study area were made showing the location of territories. Movement within territories could not be plotted. Intra-male distances, and distances between the nests and the main display spot of the nearest male were measured.

Grass height was measured once every week. Measurements were of the maximum length of each plant/tussock, and between 50 and 100 readings were taken at each site.

Most data on the lesser florican are from 1986 in which year the maximum number of males were seen.

#### RESULTS AND DISCUSSIONS

**Establishment of Territories:** Prominent activities and number of male lesser florican present during the early part of the breeding season are given for three grasslands with varying grazing pressures in Table 1.

The pre-territorial period was characterized by an absence of site fidelity. At Naulakha (partly grazed), floricans moved over large distances, from one ridge to another, or between crop fields and grassland. Display leaps by males were sporadic, and not at specific sites. The individual frequently left the location where it displayed to forage or roost elsewhere. During the pre-territorial period, when a male was flushed, it usually flew well away from the site of disturbance. The subsequent increase in site fidelity was marked by periods of sustained display at some locations. However, during this period males still moved away from the site either while foraging or when flushed. In all years of study, territory occupancy and sustained display began at Naulakha only after grazing had stopped (Fig. 1).

The chronology of territory formation at

both Hazariya and Rampura grasslands (where there was no grazing during the monsoon) differed significantly from those at Naulakha. The pre-territorial period was significantly shorter at Hazariya and Rampura than at Naulakha. At both Hazariya and Rampura grasslands, males established territories soon after their arrival. Thus, by the time territory occupancy occurred at Naulakha, floricans had been displaying from established sites at both Hazariya and Rampura for some weeks (Table 1). Once grazing had stopped at the Naulakha grassland males established territories almost immediately (Fig. 1). The territorial period was characterized by males landing close to or within their territory on being flushed.

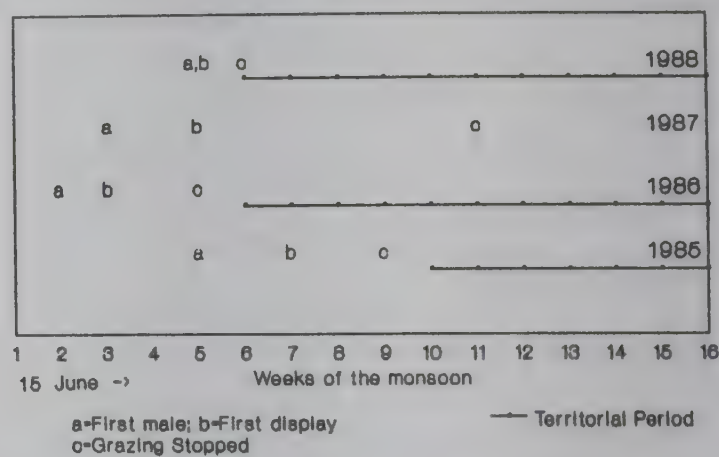


Fig. 1. Salient features of territory establishment in the Naulakha Grassland.

**Effects of livestock grazing on territory occupancy:** The single biggest inhibitor of grass growth in the lesser florican's breeding habitat is grazing by domestic livestock. When grazing pressures are high, as is often the case with domestic livestock, net loss in productivity and changes in species composition are seen (Owaga 1980, Crawley 1983, Bock *et al.* 1984). In community grazing lands (constantly grazed) adjacent to the study areas, grazing pressures are high with approximately one head of livestock per hectare. In these areas, grasses do not grow to more than 5 cm while in all types of protected



TABLE 1  
SALIENT ACTIVITIES OF MALE LESSER FLORICAN IN THE PRE-TERRITORIAL AND EARLY  
TERRITORIAL PERIOD AT THE THREE GRASSLAND STUDY SITES

Weeks	Salient Activities		
June 22 ⇒	Naulakha grassland partly grazed.	Hazariya grassland seasonally grazed.	Rampura grassland ungrazed.
1	No site fidelity; No displays; 2 males present.	No data.	No data.
2	No site fidelity; few display jumps seen; 4 males seen.	Sustained display; males territorial; 2 males present.	No data.
3	No site fidelity; sporadic displays; 3 males present.	Sustained display; males territorial; 2 males present.	Sustained display; 5-7 males territorial; 1-2 males no site fidelity.
4	1 male sustained display & territorial. 1-2 males not site specific; 2-3 males present.	Sustained display; males territorial; 3 males seen.	Sustained display; males territorial; >10 males present.
5	1 male territorial; 2 partly site specific; sustained display; 3 males seen.	Sustained display; males territorial; 3-4 males present.	Sustained display; males territorial; >10 males present.
6	Sustained display, 6 males territorial; 7 males present.	Sustained display; males territorial; 3-4 males present.	Sustained display; males territorial; >10 males present.
7	Sustained display; 8 males territorial; 9 males present.	Sustained display; males territorial; 3-4 males present.	Sustained display; males territorial; >10 males present.

For grazing pressures see study area.

N. B. Naulakha and Hazariya data of 1986; Rampura of 1988.

grasslands, grasses grow to over 50 cm during monsoon.

A two fold effect of livestock grazing is evident. Firstly, grazing reduced growth rates and net height of grasses. Secondly, levels of disturbance to the lesser florican was high due to the presence of livestock and graziers. In both Rampura and Hazariya, disturbance was minimal while at Naulakha it was maximum.

Lack of sufficient grass cover inhibits male lesser florican from becoming site specific. This was seen both in formation of territories and in

behaviour subsequent to territory formation. Males in the partly grazed grassland (Naulakha) took a significantly longer time to establish territories. Once established, males were not site specific in choice of display sites within their territories due to a lack of sufficient grass cover. Due to rapid grass growth at Hazariya and Rampura, males swiftly established territories and because of adequate grass cover began displaying from specific sites (called 'jumping spots') within their territories.

The result of disturbance was that floricans



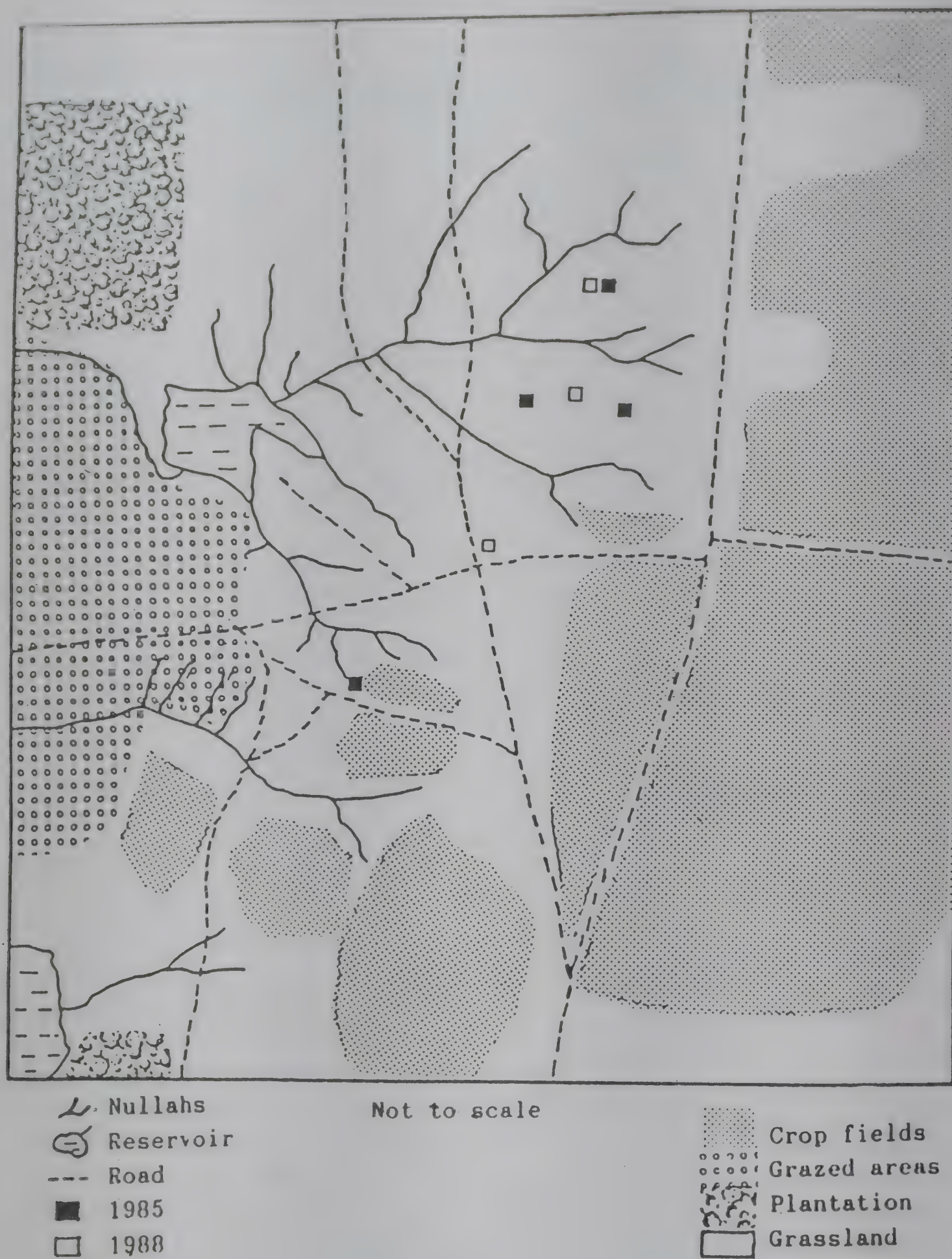


Fig. 2. Location of Lesser Florican territories at Naulakha in 1985 and 1988.



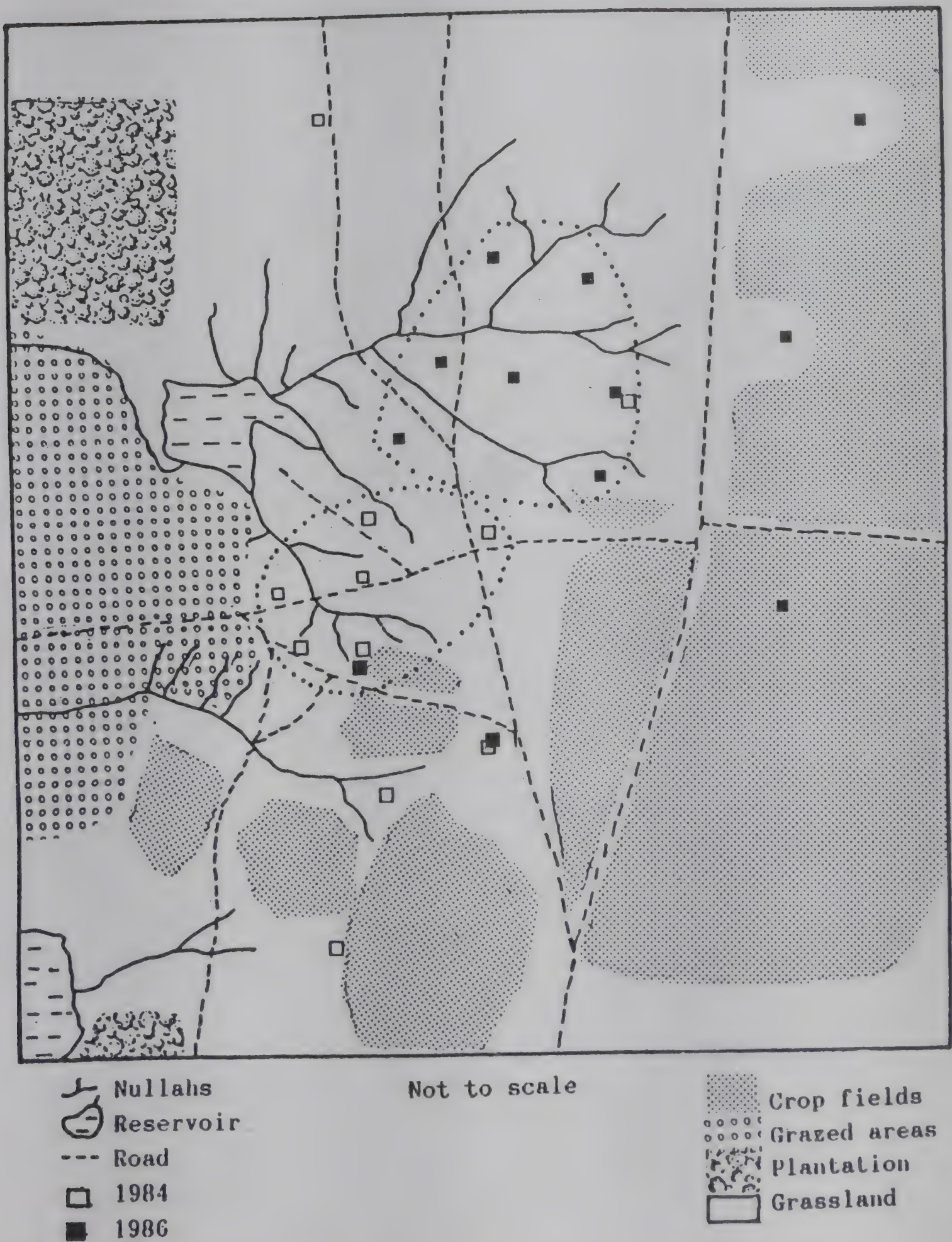


Fig. 3. Location of Lesser Florican territories at Naulakha in 1984 and 1986.



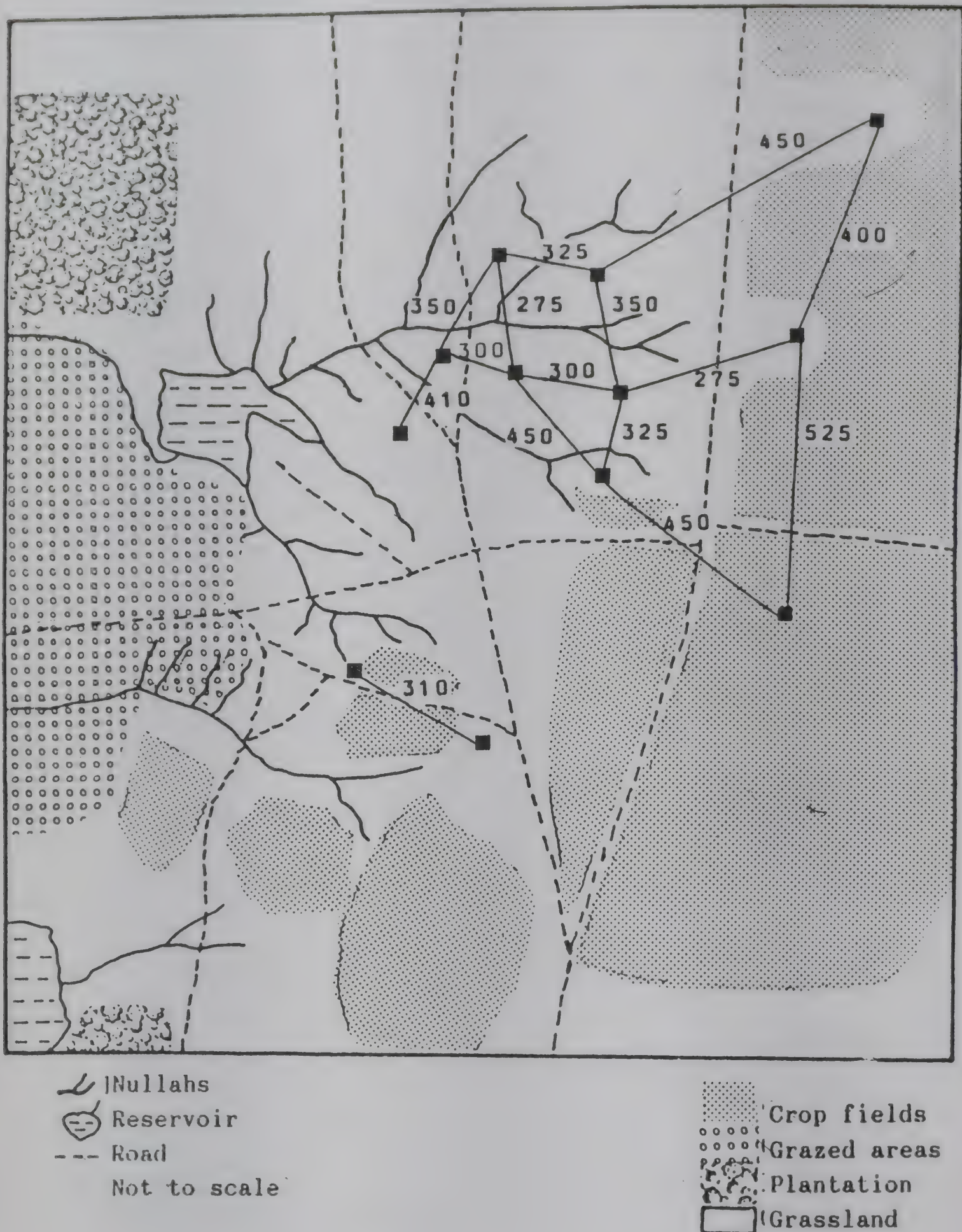


Fig. 4. Distance between Lesser Florican at Naulakha in 1986.



were frequently flushed and would move into less disturbed areas such as crop fields. Constant flushing and disturbances during the grazing period at Naulakha prevents floricans from establishing territories in the grassland until grazing stops. The effects of grazing are most severe in years of sub-optimal rainfall, when the loss of grass cover to grazing in partly grazed grasslands results in greater delays or even a complete absence of breeding. However, in ungrazed or seasonally grazed grasslands net grass heights provide sufficient cover for initiation of breeding even in sub-optimal rainfall years. For example, though 1987 was a drought year, there was sufficient grass cover in Rampura for floricans to initiate breeding, but at Naulakha, males did not even establish territories.

**Location, Size, Duration of Possession, and Distance between Territories:** The topography was undulating in all study areas and every territory included ridge tops (Fig. 5), from which most displays were performed. As display constitutes a major portion of the diurnal activity, ridge tops were the most used areas within the territory. Often the territorial boundaries were streams between the ridges, paths or roads.

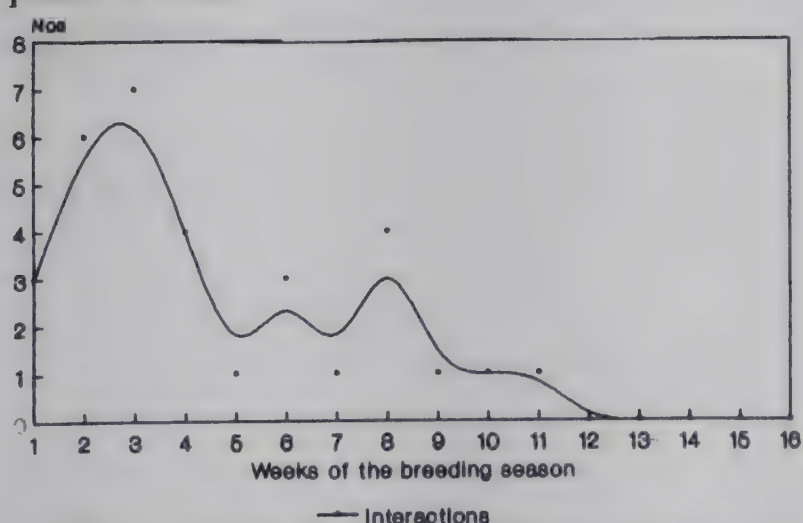


Fig. 5. Seasonal variation in occurrence of agonistic interaction.

The size of each territory was about 2 hectares, though this varied between males. The

inter-male distance was significantly greater at Rampura than at Naulakha or Hazariya as the ridges there were much larger. The distances between the display sites of males at Naulakha is given only for 1986, as the maximum number of birds were seen in that year. The mean distance between the main display spot of 12 males and their nearest neighbours was  $366.3 \pm 76.45$  m (range 275-525 m, Fig. 4). There were two areas of territory concentration (see below), about 2 km apart (Fig. 3). The distance between males increased (Figs. 2, 3), in years when there were fewer males.

The number of territories seen in a grassland varied from as high as 3 in a 9 ha. grassland to as low as 1 in 600 ha. (range of grassland areas: 9-2700 ha.). The average numbers of territories in 100 ha. of grassland was  $4.7 (\pm 9.5; n=42$  grasslands). A significant relation was seen between size of grassland and the number of territories present ( $r = 0.59$ ,  $df = 40$ ), however, considerable variations are seen and the size of the grassland was found not to be indicative of the number of territories present. Moreover, because of strong inter-annual variation in dispersal patterns as a result of fluctuations in the south-west monsoons, the number of males forming territories at a site varies between years (Sankaran 1991, Sankaran *et al.* 1992).

The duration of territory occupancy varied between years; years with early and normal monsoon had the longest territorial period. In both 1986 and 1988 this was 11 weeks. The late commencement of rains in 1985 resulted in a territorial period of only 7 weeks. Variation in duration of territory occupancy also existed between males.

**Spatial distribution of territories:** There were two areas of territory concentration at the Naulakha grassland (Fig. 3). The location of these areas of concentration varied between



years. The clustering of territories was apparent when populations were high (1984 and 1986), but less so in years when populations were low (1985, 1988, Figs. 2, 3). In all years of study, three sites that were centrally located in the two areas of concentration were first to be occupied. Once these three locations were occupied, subsequent arrivals positioned themselves in nearby or adjacent sites. The later arrivals establish territories more quickly than early arrivals, because of lack of disturbance due to grazing (Table 1, Fig. 1). Males that established territories in the crop area during the early part of breeding season due to grazing disturbances in the grassland subsequently shifted their territories into the main grassland once grazing was stopped. The new territories were also positioned near already established ones.

**Mating systems:** Avian mating systems have been classified into promiscuous, polygynous, monogynous and polyandrous; each of which can be further sub-divided according to ecological and/or temporal classifications (Orians 1969, Emlen and Oring 1977, Wittenberger 1978, 1979; Mock 1983). The absence of protracted associations between males and females or with young in the lesser florican, rules out monogamous, polygamous and polyandrous mating systems, as in these systems males must contribute post zygotically.

Two types of promiscuous mating strategies are present, the 'lek' and the 'dispersed lek' (Bradbury 1981, Oring 1982, Payne 1984). The dispersed lek system is intermediate to classical lek and resource defence (Bradbury 1981). In this system, males occupy territories (where they display) that possess resources critical to female reproduction. Though inter-male distances are large, male territories are not uniformly dispersed over suitable habitat, but show some degree of clustering (Bradbury 1981). Often a dispersed lek system is apparent only as a result

of careful mapping (Bradbury 1981).

The mating system of lesser florican shares several attributes with the dispersed lek type. These are:

1. The grassland habitat exploited by floricans are superabundant in resources that are critical to female reproduction (Sankaran 1991). Wide distribution of resources results in males being unable to monopolize all available resources and females being independent of male territories to fulfill breeding requirements.

2. By definition, a dispersed lek system should show a degree of clustering of male territories (Bradbury 1981). This was apparent in years of higher breeding populations when dispersal of male territories was not uniform, but were clustered.

3. Prolonged association between males and females was absent. Every encounter between males and females was a brief courtship encounter. In the floricans, females appeared to have large home ranges and visited a series of territories. Even after commencing nesting, female lesser floricans were not restricted to a single territory but seemed to move between territories (Shulz 1985 for similar observations on the little bustard).

4. All six nests studied at Naulakha grassland were either on the periphery (4), or well away (2) from the male territories (Wittenberger 1978).

Thus it can be concluded that the mating system of the lesser florican is the dispersed lek type.

**Site fidelity:** There was no evidence that inter-year site fidelity, either to breeding area or territory exists. The use of the same sites by males in subsequent years was most likely due to those sites possessing prime display sites (Figs. 2, 3). Within a season, however, males showed strong site fidelity. Males could be seen in their respective territories throughout the breeding



TABLE 2  
SUMMARY OF LESSER FLORICAN RINGING DATA \*

Year	No. ringed	No. Recovered	Ringed Year	Location	
				Same	Other
1943	100	-	-	-	-
1944	99	2	1943	0	2
1945	111	0	-	-	-
1946	100	2	1944	1	2
		1	1945		
1947	67	1	1944	5	4
		1	1945		
		7	1946		
1949	11	1	1945	0	2
		1	1947		
1950	0	1	1949	0	1
Total	488	17		6	11

Total birds ringed: 499

Overall recovery: 3.48%

No. of males: 488

From same location: 1.23%

No. of females: 1

From other location: 2.25%

The one female ringed has been omitted from the calculation.

\* Source Dharmakumarsinhji (1950).

season. For e.g. two coloured marked males, were present and displayed in their territories throughout the breeding season (Ali *et al.* 1984). Based on his data Dharmakumarsinhji (1950) concluded that "(lesser) floricans are not particular about returning to the same area for breeding in which they did the previous year, though we have had some such recoveries". A recapture rate of only 1.2% at old breeding sites does not indicate any site or breeding area fidelity (Table 2).

**Agonistic behaviour:** Throughout the breeding season, male lesser floricans were

solitary. During this period a male threatened, chased or fought any other male that it came in contact with. An encounter was considered to be agonistic when displays expressing a mixture of aggression or threat and fear or avoidance are performed (Burton 1985).

Of 35 instances when two males were within 50 m of each other, 26 (74.3%) resulted in chases, threats and/or fights. In five cases (14.4%) no agonistic reactions were seen and in four cases (11.4%) the reactions could not be ascertained.

While most agonistic interactions (74.3%)



ended in chases and/or threat displays, these culminated in physical fights only occasionally (23.1%). The average duration of threat and/or chase was  $6.5 \pm 5.2$  minutes (range 1 to 15 min.,  $n = 20$ ). The duration of encounters culminating in fights were longer (avg. = 13 min.,  $\pm 3.37$  min., range 9 to 17 min.,  $n = 4$ ), due to a prolonged threat component.

Almost all encounters were between two males. There were only two exceptions to this, once each in 1985 and 1986, when three males threatened and chased one another.

**Temporal distribution of agonistic behaviour:** Agonistic interactions are clustered in the first few weeks and show a peak in the very beginning of the breeding season (Fig. 5). The breeding season was divided into three equal parts (Fig. 3). The frequency of agonistic interactions in the first and second parts of the season were similar (Kolmogorov Smirnov two sample test,  $MD = 0.4$ ,  $P = 0.82$ ) but were significantly higher than in the last part of the breeding season ( $MD = 0.80$ ,  $P < 0.08$ ). Higher frequencies of agonistic interactions are associated with the arrival patterns of males, who immigrated into grasslands until mid-August. The downward trend is associated with the increasing proportion of males that have already established territories. Only on one occasion (1985) was agonistic interaction seen at the end of the season, and this was due to an unusually late immigrant.

Aggressive behaviour is an important element of initial territory establishment in many birds (e.g. Young 1956, Mundahl 1982, Shulz 1985). In the lesser florican, males arrive in the breeding area singly and arrival is followed by a period of wandering before territories are established. Agonistic interactions are mainly seen during this period when males frequently come in contact with other males. Interactions also occur during early territorial periods, when

recent arrivals intrude into established territories. Once all males have established territories, agonistic interactions are infrequent (this pattern is similar in the little bustard *Tetrax tetrax*; Shulz 1985).

Wittenberger (1978) suggested that the use of traditional display sites should evolve whenever the propensity for females to mate at familiar sites offsets any reduction in male life expectancy. Conversely, the lack of site fidelity and therefore the absence of traditional display sites should result in females mating with 'attractive' males rather than those that have occupied specific locations (Sankaran 1991). If this is true, then it could explain why agonistic interactions are clustered in the early territorial period of the lesser florican.

The habitat in the study area was more or less homogeneous, and potential display sites always exceeded the number of displaying males. If females are not particular about mating with males at specific locations, as an absence of traditional display sites would indicate (Figs. 2, 3), then males should attempt to establish their own territories rather than attempt taking over an established one. They would then increase their mating chances by advertising themselves, as females would be seeking males rather than specific locations. This would further result in an absence of an adult male 'floating' population, which was also observed by this study. All these factors would contribute to swift establishment of territories, with agonistic interactions being clustered in the pre- and early territorial phases.

#### CONCLUSIONS

There are as yet several lacunae in our knowledge of the lesser florican's biology. Of primary significance is the lack of data on the females of this species (Sankaran 1991).



Questions such as sex ratio, dispersal pattern of females, the number of females visiting a single dispersed lek, the variation in population of females with the size of dispersed leks etc. need answering before the territorial system of the lesser florican is understood in detail. However, from the existing data certain conclusions can be drawn.

1. Grazing by domestic livestock in the florican's breeding habitat was the single biggest inhibitor of grass growth. The practice of permitting grazing for the early period of the monsoon results in delays on males establishing territories because of two reasons; a) Males need a certain amount of grass cover before they become site specific and b) disturbances from livestock and graziers.

2. All grasslands that had five or more males were >75 ha. in size. The larger the grassland, the greater the number of males that were likely to occupy it.

3. The mating system of the lesser florican is the dispersed lek type as is evident by the clustering of male territories.

4. The most salient finding of this study with regards to conservation of this endangered species is that the grassland areas must be large,

at least over 100 ha. in size. Apart from having larger number of territories, this will also result in late arrivals rapidly establishing territories rather than having to compete for already established ones. Furthermore, as females nest outside male territories, large grassland areas unoccupied by males are necessary to accommodate all nesting females.

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# POLLINATION ECOLOGY OF *MARTYNIA ANNUA* L.<sup>1</sup>

C. BHASKARA RAO AND C. SUBBA REDDI<sup>2</sup>  
(With two text-figures)

**Key words:** *Martynia*, pollination, *Xylocopa*, carpenter bee, *Amegilla*, digger bee

The Devil's claw, *Martynia annua*, is a weed that effloresces normally during July-October. The flowers are nectariferous, tubular and pendant with the corolla mouth directed laterally. Dark purple and yellow spots occur on the inside of the lower corolla lip. These spots extend from the bigger lower petal to the interior of the corolla and probably act as nectar guides. Anthesis occurs during day time and the open flowers are abundantly visited by the carpenter bees *Xylocopa latipes* and *X. pubescens*; the digger bee *Amegilla* and the hawkmoth *Macroglossom gyrans*. The reward is the nectar. During foraging visits, both carpenter as well as the digger bee gain contact by their notaeum with the essential organs and thus promote nototribic pollination. The contact of the essential organs with the proboscis of hawkmoth is rather remote. In about 30% of the flowers in a population, floral arrangement facilitates spontaneous autogamy by the contact of the curved lobe of the stigma with the dehiscent anthers.

## INTRODUCTION

Plant animal mutualistic interactions, especially plant-pollinator interactions, play a crucial role in the maintenance of stability in communities (Bawa 1990). In his discussion on pollination in relation to environmental conservation, Kavan (1975) observed that the pollinating and breeding systems of non-economic plants have not been explored, especially those of weeds which might have many unappreciated roles in maintaining insect pollinators. *Martynia annua* L. is an annual weed and is commonly known as the Devil's claw. It is distributed almost throughout India. During the growing season, it adds considerable biomass to the soil. The plant is also of some economic use (Anon. 1962). The present paper describes breeding and pollination mechanisms; the same have been discussed in relation to its weed status.

## MATERIAL AND METHODS

*Martynia annua* L. occurs in waste land and along the road side at Visakhapatnam (17°42'N, 82°18'E). Through systematic and regular visits to four sites, the flowering of four different populations were recorded. Flower production on a daily basis was recorded on 25 randomly selected inflorescences. The times of daily anthesis and anther dehiscence in relation to prevailing weather were also recorded. Pollen number per anther was determined from 10 flowers distributed over different plants following Subba Reddi and Reddi (1986). Pollen viability and stigma receptivity were studied following Subba Reddi and Reddi (1984). Pollen-ovule ratio was computed after Cruden (1977). The sugars in the nectar were differentiated by paper chromatography (Harborne 1973). The presence of amino acids and proteins in nectar was demonstrated as described by Baker and Baker (1973). Hand-pollinations were used to ascertain the prevalent mode(s) of reproduction. Also tests through emasculation were performed for apomixis. Five hundred flowers were observed for fruit

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development after their natural pollination, and the resulting fruit set, seed set and fecundity were calculated following Cruden (1976).

The visitors to the flower under different environmental regimes, the number of flowers they visited in a unit time (minute), the time (seconds) a visitor spent at the flower, pollen pick-up by the visitors and the pollen transferred to a stigma under foragers activity were studied following Subba Reddi *et al.* (1983) and, Reddi and Subba Reddi (1983).

## RESULTS

**Flowering phenology:** The seeds germinate following the first monsoon rains in June-July. The plants start flowering in the middle of July and attain peak flowering in August. Flowering is terminated by the first week of October. An individual plant may flower for 75 days (Range 58-87). In 1990, the plants appeared in March following unexpected heavy rains that lasted for about a couple of weeks. The plants continued to grow and later flowered and bore fruit. The plants disappeared early in May following the completion of fruiting.

**Inflorescence phenology:** The inflorescence is a terminal or axillary raceme. An inflorescence produces an average of 13 flowers (Range 10-18) over an average period of 14 days (Range 11-18). A single and rarely two, flowers are produced each day per inflorescence.

**Flower morphology:** Flowers are pedicellate and the pedicels orient almost horizontally. They are large, showy, zygomorphic and bisexual. The tubular corolla is 6 cm long and becomes narrow at the base. Further up it is broader with 5 corolla lips. The lower corolla lip is large and the four others are small. It is pendant, but because of the dialation on the anterior side and compression on the posterior side, and because of unequal length of

corolla lips, the mouth of the corolla orients slightly laterally. Each lip has a dark purple spot on its innerside. The large lip has yellow spots merged with the dark purple spot, which runs towards the interior of the corolla tube. The yellow spots become inconspicuous towards the interior. The combination of purple and yellow spots on the large corolla lip acts as a nectar guide for the flower visitors to direct them into the corolla tube. The stamens and style, and the stigma are housed within the corolla tube.

Stamens are 2, epipetalous, inserted. Anthers are syngeneous. The anther lobes are divergent and arranged parallel to and appressed to the upperside of the corolla. The dehiscent sides of the anthers face to the lower side of the corolla. Ovary has a single carpel with 4 locules, each of which contains one ovule. The style runs parallel to the filaments and the bilobed stigma lies 4 mm above the anthers. One of the stigmatic lobes bends back and its tip curves so that contact with the dehiscent anthers situated below is likely (Fig. 1). Actual contact between the deeply curved stigmatic lobe and the dehiscent anthers occurs in about 30% of the flowers. In the other 70%, the stigma and anther lobes are separated so that contact between them is seldom possible. The other stigmatic lobe remains straight and linear throughout the flower life time.

**Anthesis and anther dehiscence:** The flowers open each day during 0400-0500 hr in association with a temperature ranging between 24-25°C and relative humidity between 83-96%. Anthers dehisce longitudinally 48 hr prior to anthesis.

**Pollen characters:** Pollen grains are spheroidal, tricolpate with a smooth exine. The size of the grains is 77 µm. The grain production per anther averaged 9,406 (Range 8,470-10,600). Sterile grains amounted to 2.3% of the total. The ratio of pollen production per



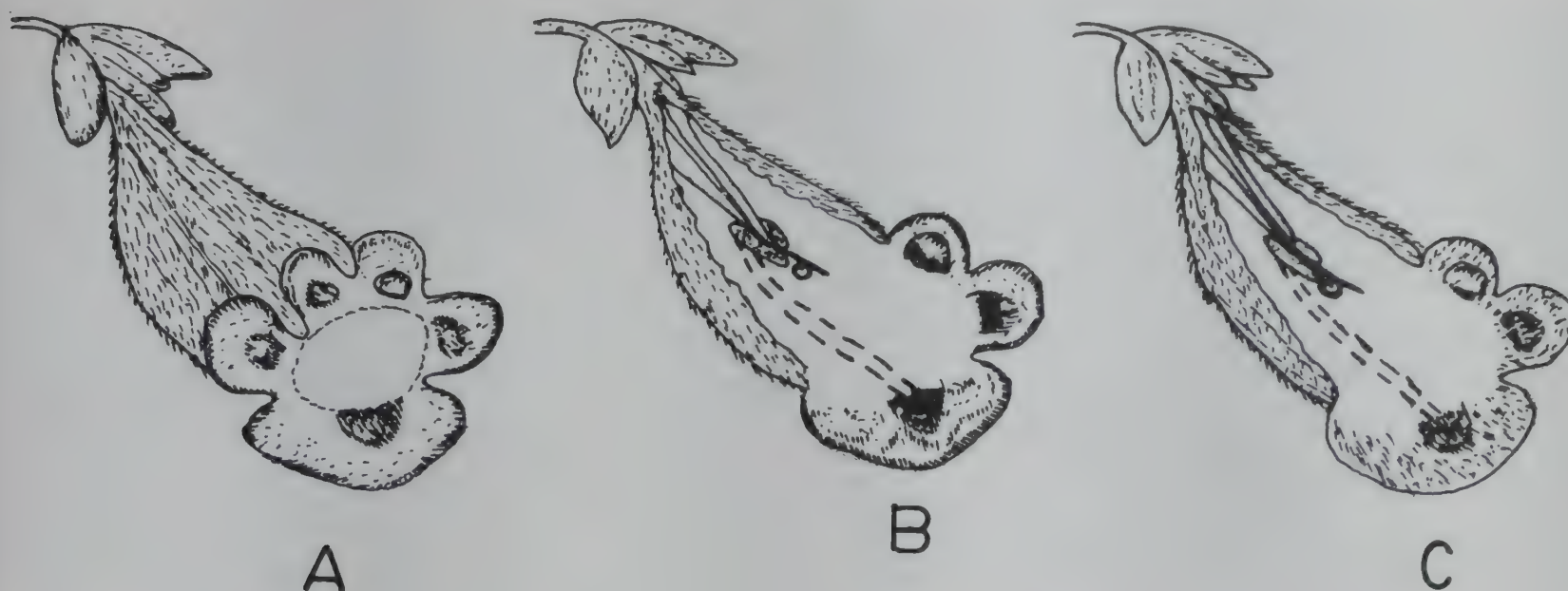


Fig. 1. The flower of *M. annua*.

A. Flower showing the shape and the mouth of corolla; B. Flower with upper petal removed to show the position of anthers and bilobed stigma with one of the lobes bent backwards. The curved stigma positioned a little away from anthers; C. Flower with upper petal removed, showing the contact between curved stigma and anthers as observed in some 30% of the flowers.

ovule is 4700:1.

**Pollen viability and stigma receptivity:** Pollen germination tests indicated that fresh pollen grains germinate to the extent of 50% in 100% sucrose solution. Hand-pollination tests for pollen viability through fruiting indicated that pollen grains are viable for 56 hr with the ability to produce fruit from 100 to 8%.

Stigmas become receptive following anthesis and remain receptive for 48 hr. The stigmas later turn black and wither. Hand-pollination tests for stigma receptivity showed that the stigmas are able of producing fruit from 100% to 8% during their receptivity period.

**Flower lifetime:** The floral parts, corolla and stamens start dropping off after 12-16 hr of anthesis. The remainder of the flower, calyx and pistil remain attached to the pedicel for some more time. Stigma turns black and drops off. This usually results 60 hr after anthesis. Calyx withers in about a week's time.

**Nectar characters:** Nectar production begins with anthesis. A single flower produces

15  $\mu$ l (Range 10-20  $\mu$ l). Nectar contains all the three basic sugars, i.e. glucose, fructose and sucrose. Sugar concentration ranged from 5-7%. The first sugar is predominant while the latter two are present in traces. Proteins and amino acids are also present in the nectar.

**Breeding behaviour:** The emasculated flowers did not fruit. Hand-pollination tests for autogamy yielded 100% fruiting, for geitonogamy 48% and for xenogamy 28%.

**Natural fruiting and fruit abortions:** The natural fruiting varies from 48 to 56%. The percentage of abortions ranges from 30 to 55%. The fruits of the basal flowers of the inflorescence rarely abort.

**Flower visitors:** The flower visitors included the carpenter bees, *Xylocopa latipes* and *X. pubescens*, the digger bee, *Amegilla* sp. and the hawkmoth, *Macroglossom gyrans*. They foraged at the flowers throughout the flowering season. The foraging visits of *Xylocopa*, *Amegilla* and *Macroglossom* were scored under different environmental conditions as sunny



days, cloudy days and days preceded by rain (Fig. 2). The percentage of foraging visits of *Xylocopa* relative to other visitors was 48.3 % on sunny day, 27.3% on cloudy day and 32.9% on days following rain. The corresponding values for *Amegilla* were 34.15, 58.6 and 52%; for *Macroglossom* 17.37, 13.3 and 16%. The data suggest that the *Xylocopa* actively forages on sunny days and on days preceded by rain. On the other hand, *Amegilla* forages actively on cloudy days and on days following rain. *Macroglossom* forages with equal intensity under

different weather conditions.

**Diurnal activity of foragers:** *Macroglossom* was the first forager on the flowers. It started its foraging activity on *M. annua* at dawn and continued up to sunrise. It again appeared at dusk after sunset and continued foraging for about 10-20 minutes; thereafter it disappeared. It maintained the same foraging schedule irrespective of changes in weather conditions. Both *Xylocopa* and *Amegilla* appeared foraging at the flowers with dawn and disappeared after sunset. They showed this foraging period on both sunny and cloudy days. *Xylocopa*'s visits were haphazard on sunny days, while its visits were relatively more during 0800-1600 hr on cloudy days. Its activity was continuous from 0800-1600 hr on days preceded by rain. *Amegilla* consistently foraged on sunny days from 0600-1200 hr and at other times of the day, its visits were haphazard.

**Foraging behaviour:** The lower large tip of the tubular and showy corolla is the landing platform for the forager. It also seems to direct the forager into the corolla tube by its purple and yellow spots located on its innerside. The bee foragers land on the large lip and then penetrate into the corolla tube following the path of the yellow spots to reach the nectary. Simultaneously, the dorsal side of the bee contacts the anthers and the stigma. Consequently, the pollen grains are deposited in the dorsal thorax-crevices of the bees. Also the stigma is coated with the pollen brought on the dorsal thorax-crevices of the bees. The bees walk back to exit from the flower. The hawkmoth hovers at the mouth of the flower and inserts its proboscis into the corolla tube to suck the deeply hidden nectar. It covers many flowers in rapid succession in one foraging bout. The proboscis may get in contact with the stigma and anthers; the probability of contact is contingent on how close the proboscis is inserted parallel to the

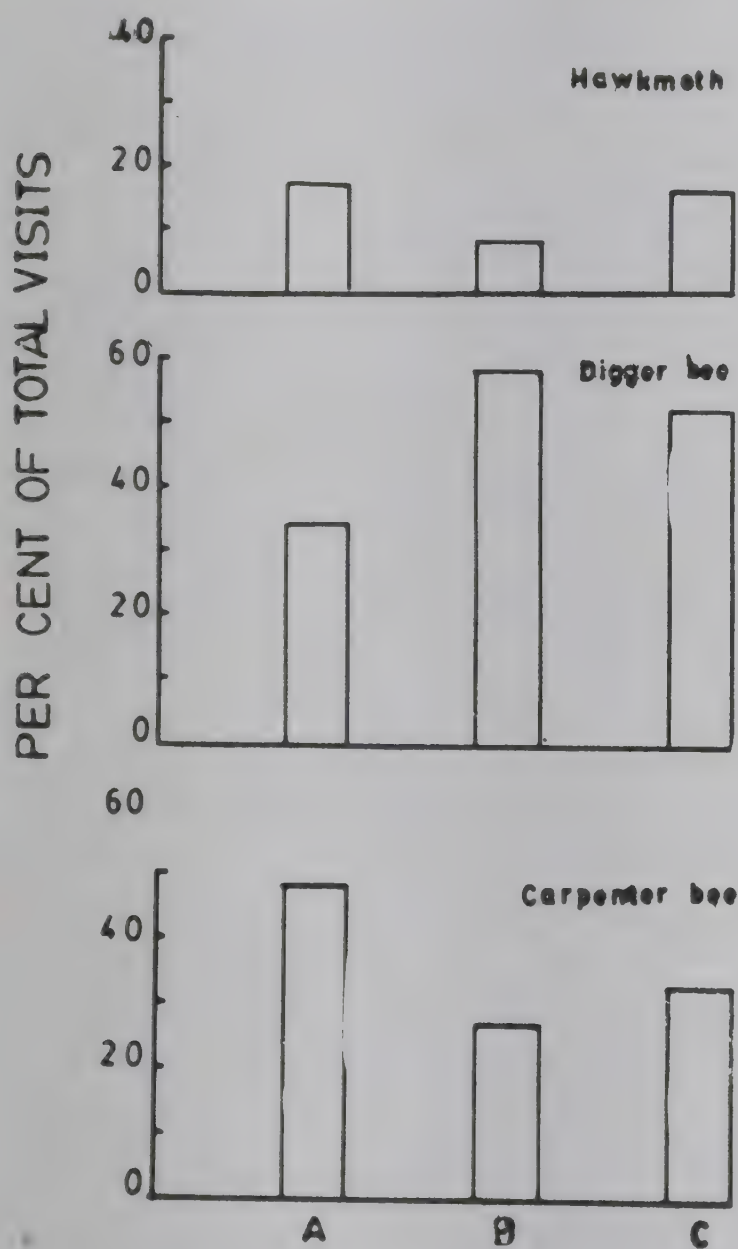


Fig. 2. Relative abundance of flower visitors on *M. annua* in different environmental regimes:  
A. Sunny day; B. Cloudy day; C. Day after rain.



essential parts of the flower.

The hawkmoth spent 1 or 2 seconds at each flower and visited 17-30 flowers per minute. Both *Xylocopa* and *Amegilla* spent 3-10 seconds at each flower and visited 4-10 flowers per minute.

**Pollen pick-up potential and transfer ability by foragers:** The carpenter bees were the most efficient in picking up pollen grains. Pollen picked up by the digger bee was relatively low compared to carpenter bees. Hawkmoth picked up a few pollen grains (Table 2).

Carpenter bees and digger bees are almost equally efficient in transferring pollen grains to the stigmas, hawkmoth transfers a few pollen grains and so it is ineffective in pollen transfer (Table 1).

bees and the hawkmoth are diurnal crepuscular in their activity. Their entry into the flowers is guided by the dark purple and yellow spots directing the way to the interior of the corolla from the larger corolla lip. The size and shape of the flowers, and the position of the essential organs parallel to and appressed to the upperside of the corolla appear to have evolved for manipulation and pollination by the carpenter bee. Such an assumption gains support from the analysis of body washings showing a greater number of pollen in carpenter bee body washings, particularly from the abdomen region. However, to judge from the ability to transfer pollen on to the stigmas as assessed by the examination of stigmatic pollen loads after visitation by different visitor species, one has to

TABLE 1

POLLEN LOADS ON STIGMA OF *MARTYNIA ANNUA* AFTER INSECT VISITATION

Name of visitor	No. of flowers sampled	1st visit			No of flowers sampled	2nd visit		
		No. of pollen on stigmas				No. of pollen on stigmas		
		Range	Mean	S.D.		Range	Mean	S.D.
<i>Xylocopa</i> sp.	7	150-173	161.6	8.78	7	168-250	210.0	28.40
<i>Amegilla</i> sp.	7	0-41	23.8	17.33	7	32-68	46.0	10.52
<i>Macroglossom gyrans</i>	7	0-32	7.5	10.30	7	3-25	12.4	7.12

# DISCUSSION

Whenever the flowers of *Martynia annua* are available either during the rainy season or during the summer season (an exception), they are visited by three different visitor species - the carpenter bee (*Xylocopa*), the digger bee (*Amegilla*) and hawkmoth (*Macroglossom*). The

conclude that the digger bee is as effective as carpenter bee in bringing about pollen transfer in *Martynia annua*, and the role of hawkmoth is negligible. Enumeration of forager's visits under different environmental regimes show that the carpenter bee is more active on warm sunny days whereas the digger bee is so on cold, cloudy days. During the period *M. annua* blooms, it is common to have conditions of overcast sky, and therefore it is concluded that



TABLE 2

POLLEN GRAINS IN BODY WASHINGS OF FORAGERS ON *MARTYNIA ANNUA*

Body part of visitor	Number sampled	<i>Xylocopa</i> pollen grains			Number sampled	<i>Amegilla</i> pollen grains		
		Range	Mean	S.D.		Range	Mean	S.D.
Head	3	22-32	27.33	4.10	3	12-13	12.30	0.47
Abdomen	3	418-540	488.00	57.40	3	18-26	22.00	3.26
Thorax	3	26-140	85.33	57.15	3	5-20	13.00	6.16
Legs	3	-	-	-	3	6-8	11.30	4.98
Wings	3	128-280	202.00	62.08	3	53-66	58.00	5.71

both the carpenter and the digger bee are important in rendering pollination service to *M. annua*.

The visits of hawkmoth may indirectly benefit the plant. Heinrich and Raven (1972) postulate that the amount of nectar produced by a flower must be sufficient to attract a pollen vector but not so much as to satiate the vector. Based on the observation cited in Free (1970) that clover flowers robbed of their nectar had increased fruit set, Cruden (1976) suggests that the number of flowers visited, hence pollination and fruit set, should be maximum when the amount of nectar is minimal. Hawkmoth with its proportion of visits ranging from 13-17% of the total, mostly confined to dawn and with its speed of foraging, might remove much of the nectar and keep the same at minimal volume, so much so that the other two bee species visit a large number of flowers to fulfil their energy requirement. Of course, the rate of nectar replenishment following removal is also a factor influencing the frequency of visits.

In about 30% of the flowers in a population of *M. annua*, spontaneous autogamy is facilitated

by the contact between the dehiscent anther lobes and the curved lobe of the stigma. In the other 70% of the flowers in a population, artificial pollinations resulted in 100% success in autogamy, 48% in geitonogamy and 28% in xenogamy. However, when either of the bee species enters the flower, they first come into contact with the bilobed stigma which is about 4 mm away from the anther lobes, and being sensitive to the contact stimulus, the stigma closes. Thus, any pollen deposition upon the stigma is likely to occur on visitors entry, but not on visitors exit. It is thus clear that visitors foraging activity promotes either geitonogamy or xenogamy. Since the occurrence of xenogamy increases when small number of flowers open at any given time (Cruden 1976), the production of one or two flowers daily in an inflorescence might be a device favouring xenogamy. Since both the bee species exhibited interplant and interpopulation flights, it is likely that the foragers might effect more of xenogamous pollinations.

*Martynia annua* is a weed. Spontaneous autogamy ensures enough fruiting even in the



absence of insect visitation. It has recently invaded the biotope of the study area and therefore may be considered as successful coloniser. Allard (1965) stated that autogamous species with a provision for out crossing are more suitable for colonising many different niches that are found in weed habitats. Such a genetic system results in most individuals being homozygous and the perpetuation of best adapted genotypes for various specific micro-environments, whereas the mating system of a strict outbreeder does not produce continual specific genotypes adapted to specific

environmental niches. Mulligan (1972) states that, if many different inbred intraspecific populations are indeed produced by autogamous weeds with some amount of outcrossing this would certainly account for their remarkable ability to occupy rapidly the many uniform microenvironments that are created by man's disturbances.

#### ACKNOWLEDGEMENT

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# CIRCADIAN VARIATION IN THE MOVEMENT OF FRY IN A FEEDER CANAL<sup>1</sup>

C.R. AJITHKUMAR<sup>2</sup> AND A. ASTHANA<sup>3</sup>

(With ten text-figures)

**Key words:** *Chanda* sp., *Cirrhinus* sp., *Labio* sp., *Notopterus* sp., diurnal, nocturnal, rhythm, phototaxis

The study was conducted in a feeder canal supplying water to the wetland of Keoladeo National Park, Bharatpur (Rajasthan). Some species of fry showed striking temporal variation in their movement. *Chanda* sp., *Oxygaster* and *Cirrhinus* fry were diurnal, while that of *Notopterus*, *Wallago* and *Ompok* were nocturnal. *Labio* and *Puntius* did not show distinct diurnal or nocturnal pattern. Among the physico-chemical parameters of water, DO was positively correlated with the abundance of *Chanda* ( $r = 0.69$ ) and negatively with that of *Notopterus* ( $r = -0.63$ ). Other species did not show any such relation. The inherent biological rhythm seems to be the determining factor more than physico-chemical properties of water.

## INTRODUCTION

Animals commonly confront environmental changes that are cyclical, such as days, tides and seasons and many maintain some sort of internal rhythm, or clock. One of the most important among them is day and night. This change affects the animals both directly and indirectly. Thus there may be changes in food availability and number of predators, which are brought about by changes in temperature, light intensity etc. Published work on this aspect of fish is rather scanty.

Payne (1986) reported that some fishes are diurnal and some are nocturnal in habit. In the marine environment diurnal variation in the catch was noticed in silver bellies (Venkatraman and Badrudeen 1975), in grey mullet seed at Mandapam (James *et al.* 1980) and in the trawl fisheries (Jayaram *et al.* 1959).

Diurnal variation in the movement of freshwater fishes has not been often reported. Phototaxis studies conducted in fish embryos and

adult fish in situ revealed that some of them showed negative phototaxis while most others were positively phototactic in nature (Jain and Sahai 1980).

The present study was carried out in the renowned wetland the Keoladeo National Park, Bharatpur, Rajasthan.

## METHODOLOGY

Every year, the park gets water from an outside temporary reservoir, Ajanbund. The water is brought to the park through a canal, namely Ghana canal from which it is distributed to various blocks by means of sluice gates. This water also brings millions of fish fry, micro- and macro-invertebrates and debris.

The gear used to sample the fry was a modified version of stow net (framed bag net) described by Brandt (1974). The net was made up of mosquito netting and was conical with a funnel-like tapering end extending to a metre. It had a square mouth of 1.5 m x 1.5 m.

Samples were collected using the stow net from the main canal at a point near a bridge, much before the water gets diverted to different blocks of the sanctuary. The net was dipped into the water holding both sides close to the pillars,

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keeping the lower side touching the bottom. It was held in such a position for a minute and then lifted to collect the fry which were counted genus wise. Two samples were collected from each site and four such samples were taken at a time to cover the whole width of the canal. When the number of fry in each collection became extremely high, leading to counting error and high mortality, the operating time was reduced to 15 seconds. To find out diurnal variation in the movement pattern of fry, collection was carried out for 24 hours with one hour intervals in 1988.

Along with the fry samples, physico-chemical properties of water such as water temperature, pH, DO and alkalinity were also recorded using standard methods (APHA/AWWA/WPCF 1985).

#### RESULTS AND DISCUSSIONS

The present study shows that *Chanda* sp., *Oxygaster* sp., *Cirrhinus* sp., *Notopterus* sp., *Ompok* sp., and *Wallago* sp. have a marked difference between the night and day time

nektonic, whereas their eggs and fry are considered to be planktonic. The study revealed that fry move at their will and are not fully at the mercy of the current, and hence are not planktonic in nature. *Chanda* sp. and *Oxygaster* sp. could be considered as mainly diurnal species, whereas *Notopterus* sp. and *Wallago* sp. as nocturnal ones. *Puntius* sp. and *Labio* sp. did not show a particular pattern.

#### Diurnal species:

1. *Chanda*: This glass fish genus includes two species, namely *Chanda nama* and *C. ranga*. The latter is almost oval in shape while the former is slightly elongate with lower jaw slightly longer than the upper jaw with two teeth on it. This larval fish attains maximum size of only 7 to 8 cm and forms one of the major species of fry that enters the park. Significant difference was observed in their night and day movement ( $T = -6.72$ ,  $P < 0.001$ ). It was abundant between 05.00 a.m. to 19.00 p.m. and was rare during night (Fig. 1). To confirm this observation, a series of data were collected in

TABLE 1  
DIURNAL VARIATION IN THE FISH FRY OF DIFFERENT SPECIES RECRUITMENT

Species	Cha.	Oxy.	Cir.	Omp.	Lab.	Pun.	Che.	Pse.
Chi-square	30.372	19.277	56.768	107.328	1.249	6.846	0.923	15.775
P<	0.01	0.01	0.01	0.01	NS	0.009	NS	0.01

NS = Not significant.

Cha. - <i>Chanda</i> ;	Cir. - <i>Cirrhinus</i> ;	Lab. - <i>Labio</i> ;	Che. - <i>Chela</i> ;
Oxy. - <i>Oxygaster</i> ;	Omp. - <i>Ompok</i> ;	Pun. - <i>Puntius</i> ;	Pse. - <i>Pseudiotropis</i> ;

movement (Table 1). *Notopterus* sp. and *Wallago* sp. were only recorded in the night.

**Movement pattern of different species:** Rhythmicity, either endogenous or exogenous, is commonly found in all organisms. Fish are

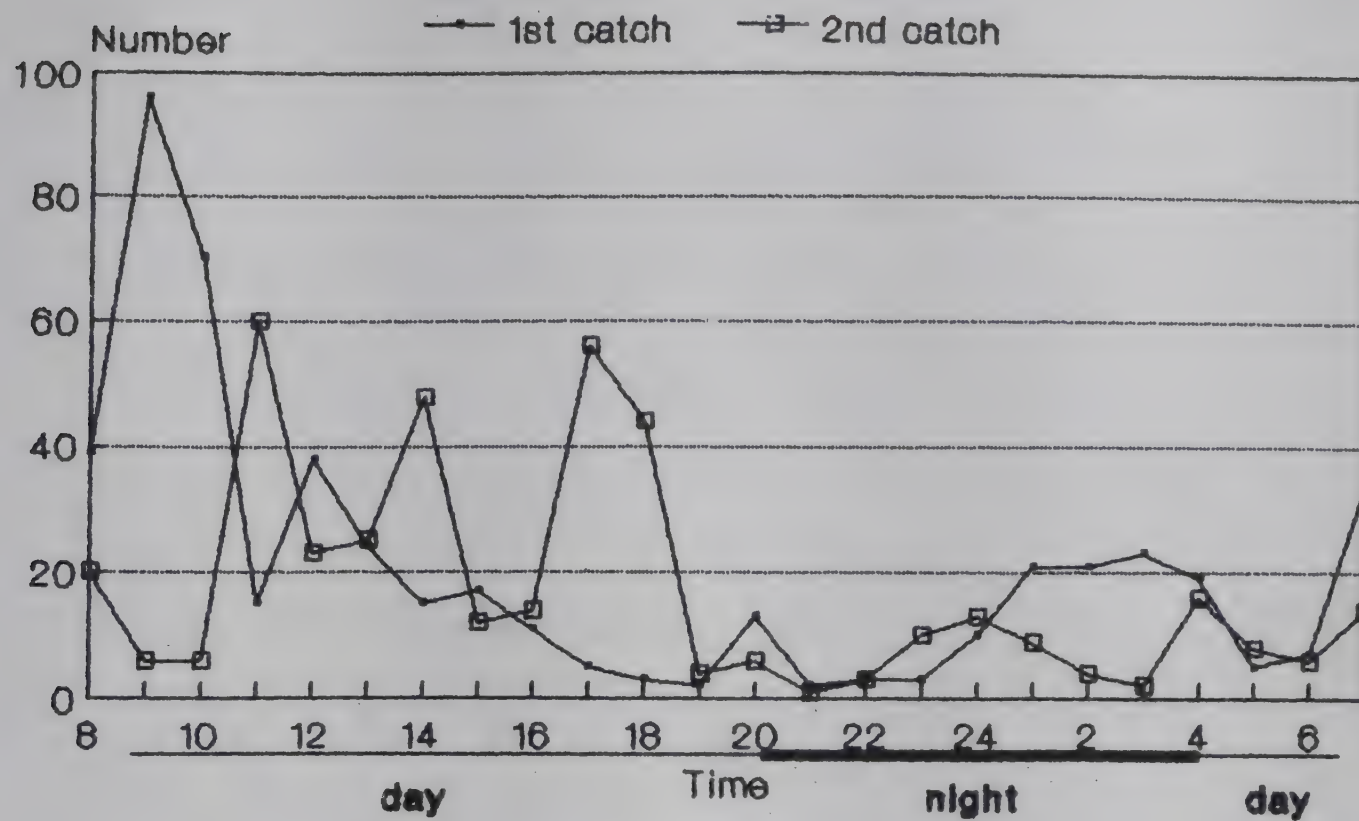
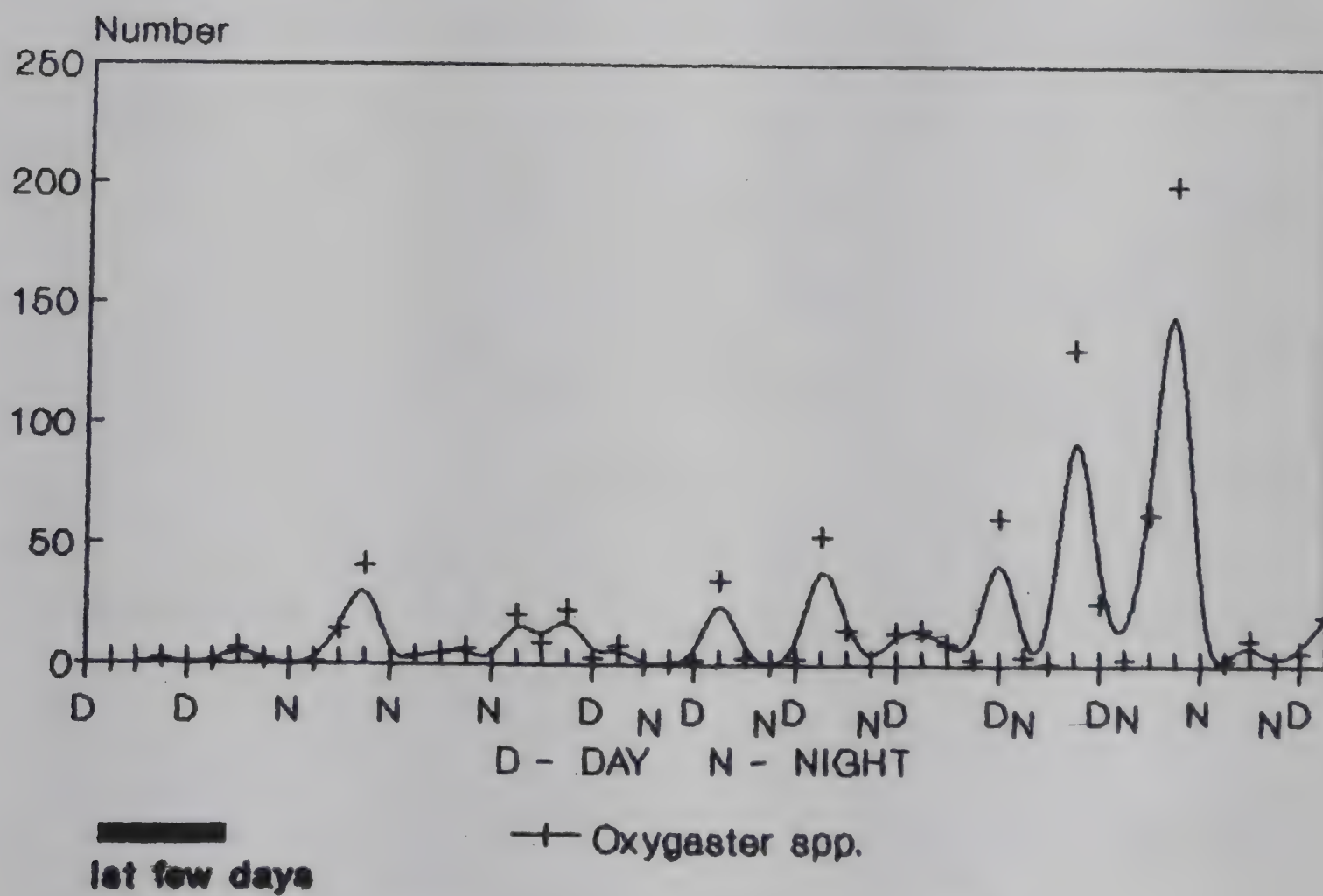
1988. The continuous oscillation is very clear (Fig. 2).

2. *Oxygaster*: The silvery shining genus *Oxygaster* includes *Oxygaster bacaila* and *Oxygaster chupeoides*. *O. bacaila* is slightly

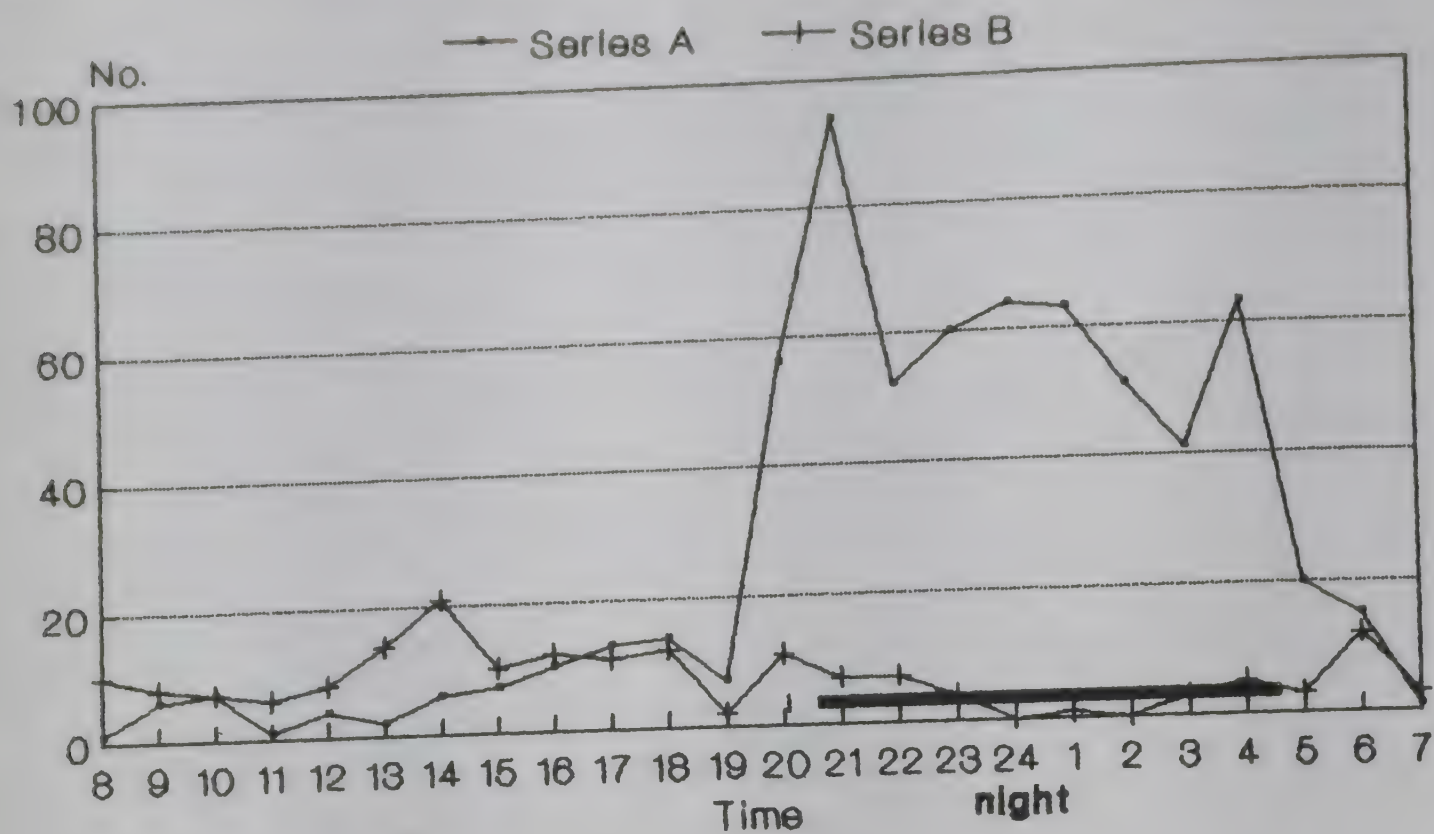
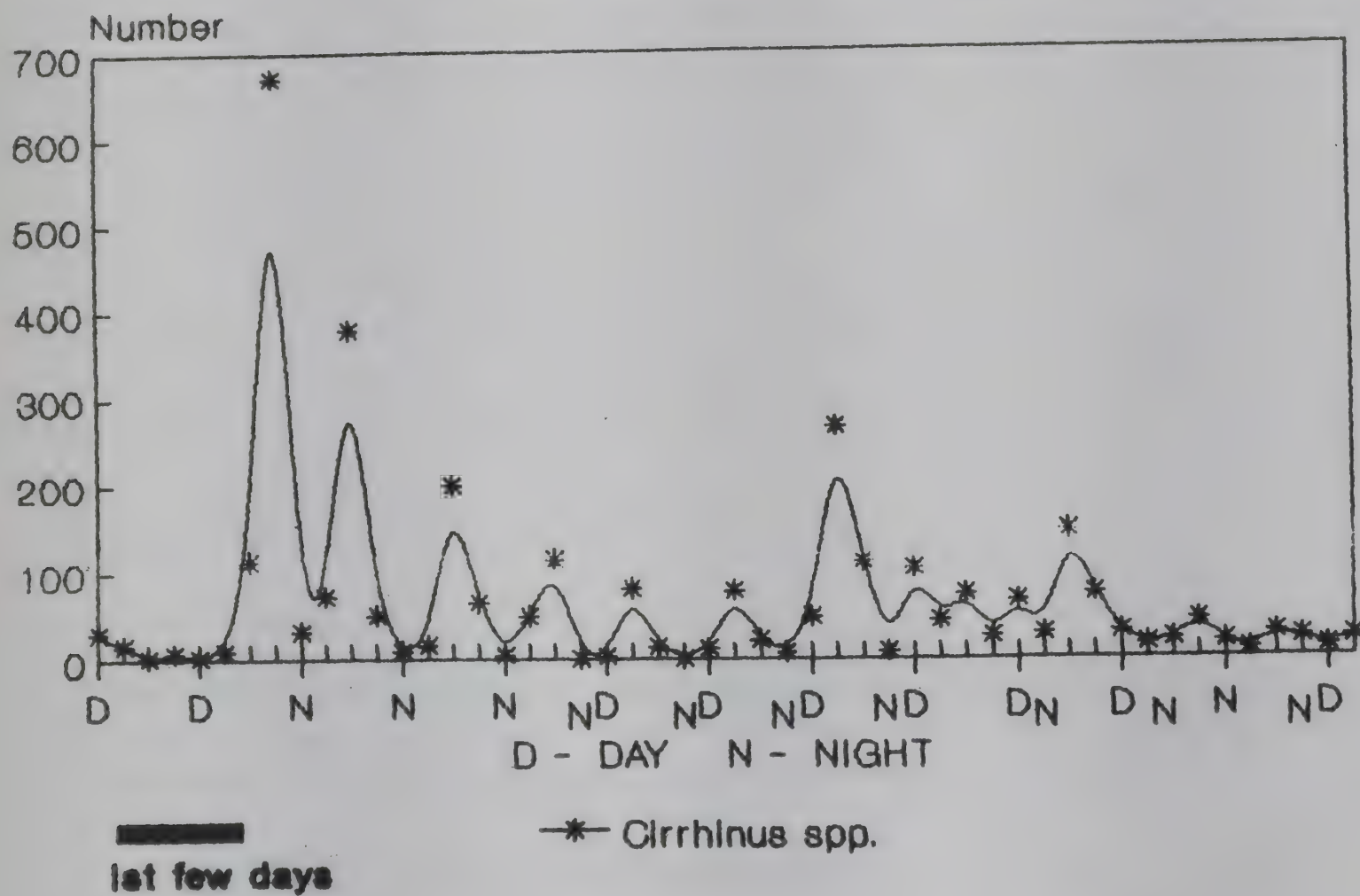




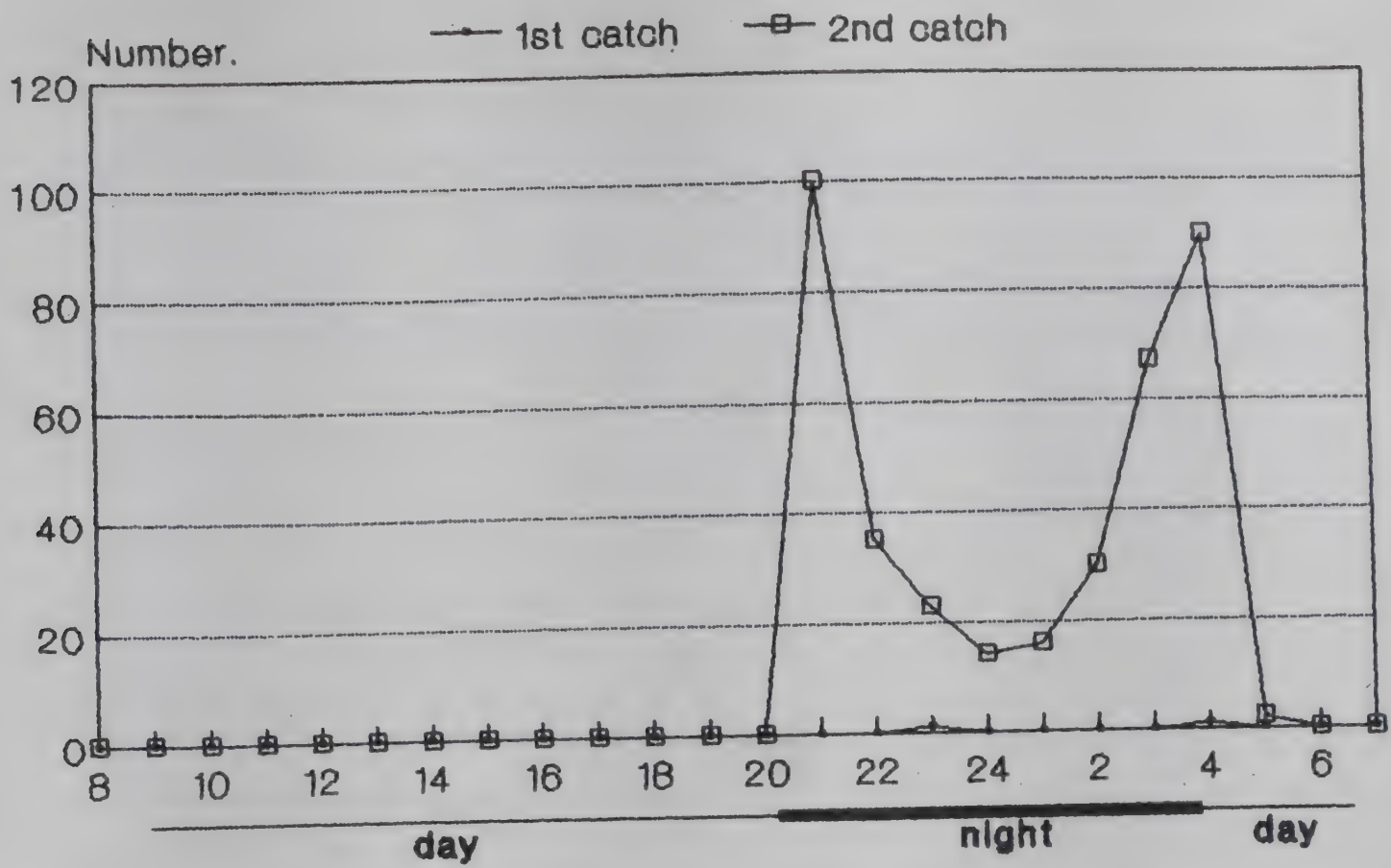
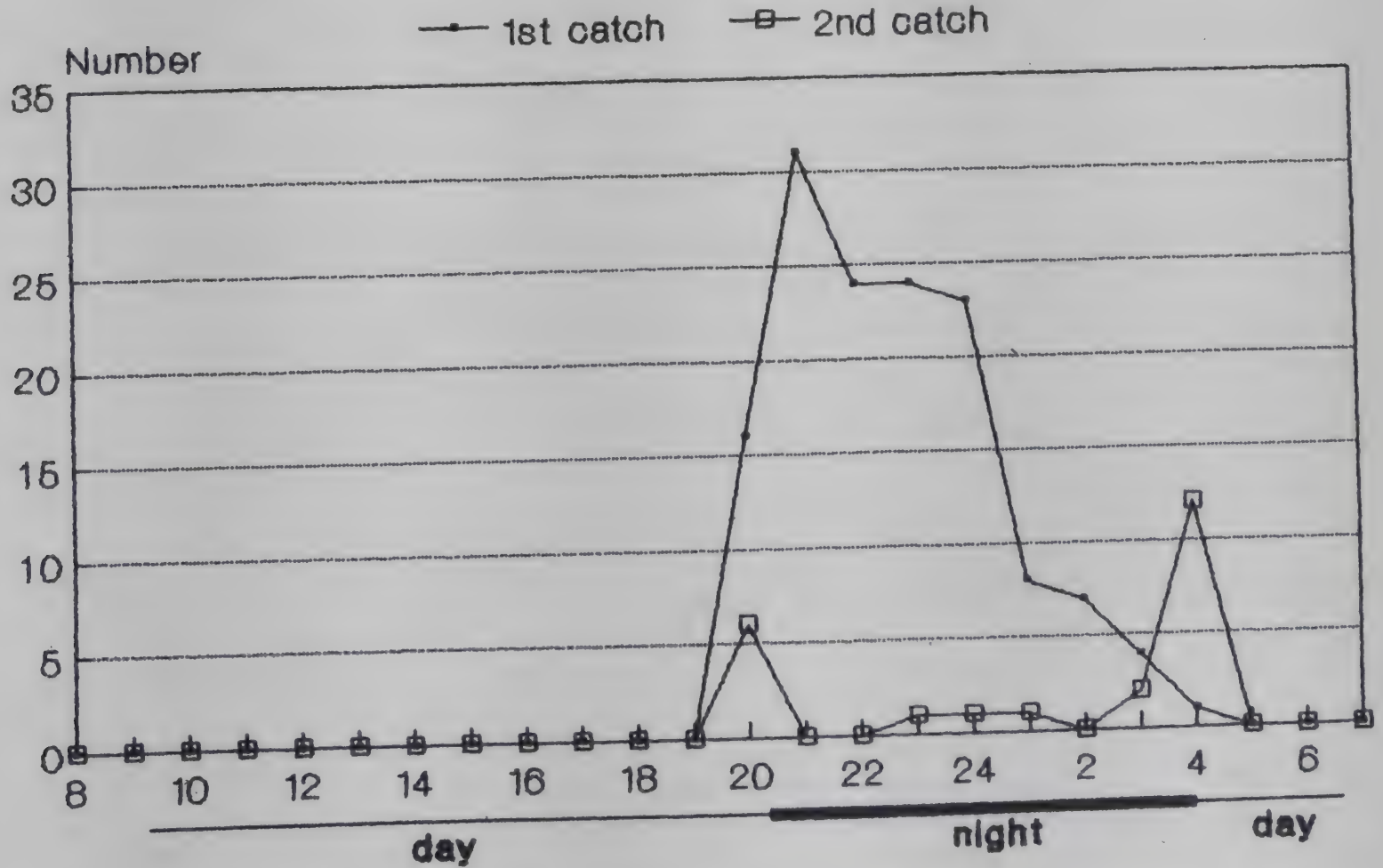


Fig. 3 Circadian rhythm in the movement of *Oxygaster* sp.Fig. 4. Catch pattern of *Oxygaster* sp. during 1988.



Fig. 5. Circadian rhythm in the movement of *Cirrhinus* sp.Fig. 6. Catch pattern of *Cirrhinus* sp. during 1988.



Fig. 7. Circadian rhythm in the movement of *Notopterus notopterus*.Fig. 8. Circadian rhythm in the movement of *Wallago attu*.



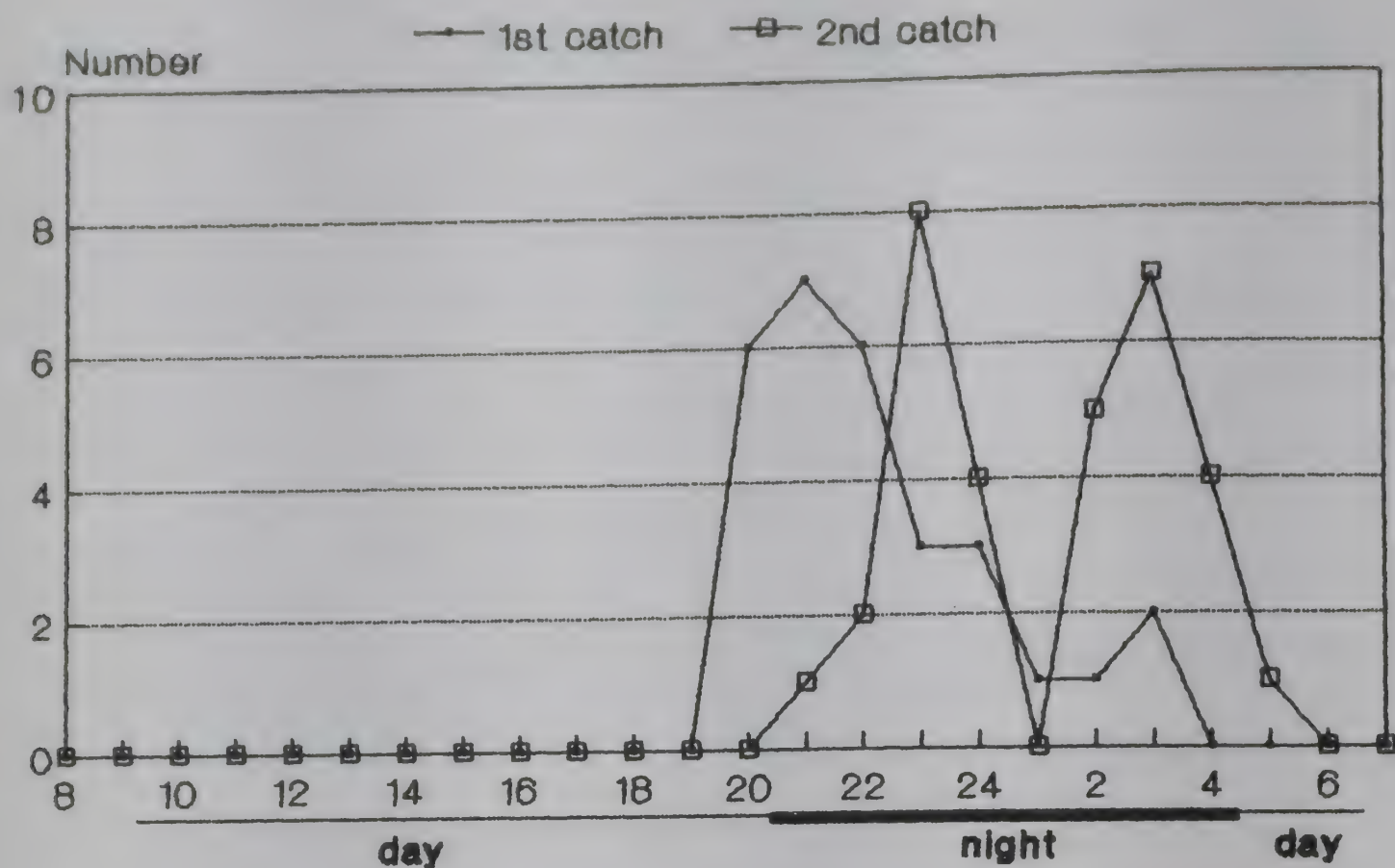
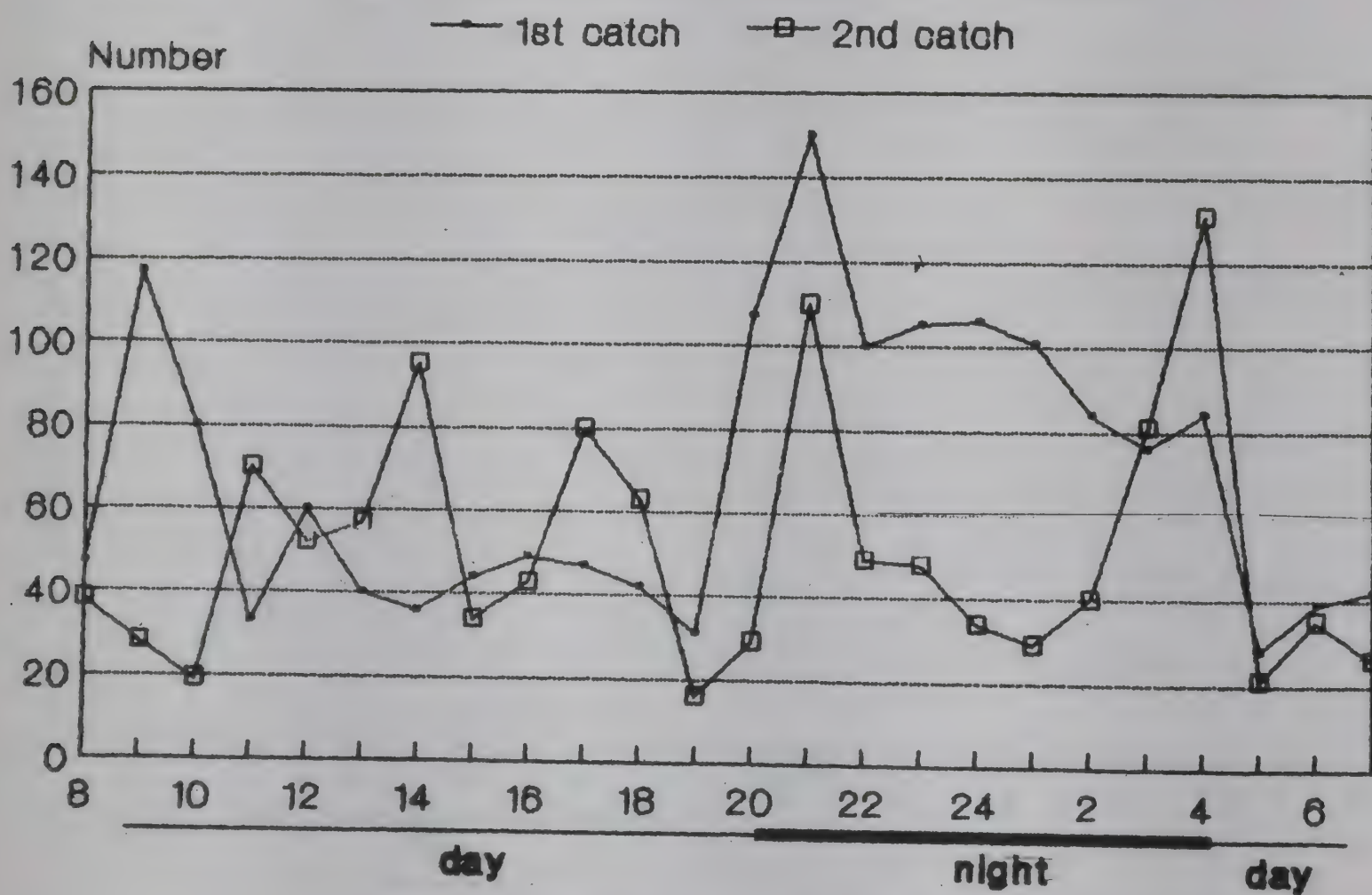
Fig. 9. Circadian rhythm in the movement of *Ompok bimaculatus*.

Fig. 10. Total catch variation of fry in different hours.



larger than *O. clupeioides*.

This species also followed the same pattern as that of *Chanda* sp. and showed significant variation in day and night movement. They were also more during the daytime rather than at night ( $T = -2.536$ ,  $P = <0.015$ ) (Fig. 3). The series data reaffirmed the pattern of oscillation in *Oxygaster*.

3. *Cirrhinus*: The genus *Cirrhinus* included the major carp *Cirrhinus mrigala* and minor carp *Cirrhinus reba*. The latter was more common than the former.

In the first collection, *Cirrhinus* sp. were recorded more in the night catch, but in the second collection they formed the day's catch. The dominance of this species in the night may be an accidental one, because 1988 series collection confirmed the exact nature of the species. It was confirmed to be a diurnal species (Fig. 6).

#### Nocturnal species:

1. *Notopterus notopterus*: The genus

considered to be locally extinct (Kumar and Vijayan 1988). *N. notopterus* was recorded only at night. During the first collection, two adult fish were recorded at night but in the second collection large number of fry were recorded. This may be due to a slight shift in the breeding time. The nocturnal pattern was very clear (Fig. 7).

Other studies on *N. notopterus* showed that larvae of this species showed a negative phototaxis which might have resulted ultimately in the nocturnal habit (Jain and Sahai 1980).

The eyes of *N. notopterus* are adapted for an active, nocturnal activity. The eyes are slightly larger than that of other fry and like that of nocturnal animals, the eyes have a heavily pigmented layer lined by a silver *tapetum lucidum* having crystalline plates of guanine. This type of eyes is more common in elasmobranchs (Verma *et al.* 1980).

2. *Wallago* and *Ompok*: Both these genera of catfish have one species each - *Wallago attu* the freshwater shark and *Ompok bimaculatus*. They showed nocturnal active habit (Figs. 8, 9).

TABLE 2

RELATION BETWEEN THE FRY OF MAJOR FISH SPECIES AND PHYSICO-CHEMICAL PROPERTIES OF WATER  
(CORRELATION COEFFICIENT  $r$ )

Species	Water Temperature	pH	DO	Total Alkalinity
<i>Chanda</i> sp.	0.1919	0.0548	0.6948*	0.093
<i>Oxygaster</i> sp.	-0.160	-0.126	0.2825	-0.1081
<i>N. notopterus</i>	-0.0557	-0.3731	-0.6272*	0.0635
<i>W. attu</i>	0.0937	0.3945	-0.4525	0.2674
<i>Cirrhinus</i> sp.	0.4564	-0.4603	-0.2305	0.3629

\* Significant

*Notopterus* was represented by one species *N. notopterus*. The other species *N. chitala* is

Species such as *Labio* sp., *Puntius* sp., *Chela* sp. and *Mastacembalus* sp. did not show any



difference in their day and night movements.

**Physico-chemical properties of water:** During the 24 hrs sampling of fry, physico-chemical parameters of water such as DO, pH, alkalinity (Methyl orange) and water temperature were also recorded and, these were correlated with the abundance of each species. The result shows that DO is positively correlated with *Chanda* ( $r = 0.6948$ ) and negatively with *Notopterus* ( $r = -0.6272$ ) (Table 2). Other species did not show any correlation with any of the physico-chemical properties of water. Even though there was correlation with the chemical properties of water with two of the species, they might have evolved their rhythm so as to be active in the respective time of the day.

The biological factors responsible for the behaviour may be predation and food. To avoid predators, species may prefer to be active at night. Diurnal species are more silvery shining or transparent, for example *Oxygaster* sp. and *Chanda* sp. The nocturnal species (*N. notopterus*) is dark compared to diurnal ones. This may help the fry to escape from predators.

It is already known that plankton show diurnal variation. All fish fry except *Wallago attu* are considered to be plankton feeders and the availability of some particular plankton may affect the activity of specific fish species.

#### ACKNOWLEDGEMENTS

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# FURTHER OBSERVATIONS ON PHAYRE'S LEAF MONKEY (*TRACHYPITHECUS PHAYREI*) IN CACHAR, ASSAM<sup>1</sup>

ANWARUDDIN CHOUDHURY<sup>2</sup>  
(With two text-figures)

**Key words:** leaf monkey, distribution, habitat, social behaviour, territory, hunting, Innerline RF

After discovery and initial observation in 1986, more observations were made on Phayre's leaf monkey in Cachar (including Hailakandi) during the subsequent years. Aspects covered included distribution, habitat and socio-behavioural studies like habits, territoriality, social organisation, etc. Four troops have been discovered in the area, besides confirming its wide distribution throughout southern Cachar, Hailakandi and Karimganj. Habitat destruction due to *jhum* cultivation and hunting by the Mizos for food continues to threaten its survival.

## INTRODUCTION

The discovery of Phayre's leaf monkey (*Trachypithecus phayrei* Blyth, 1847) in Cachar, Assam and some observations on its habitat and status in 1986 have already been discussed (Choudhury 1988). Subsequently more field trips have been made in different parts of Cachar (including Hailakandi) in February, 1987 and April, 1988. In this paper, observations made on various aspects of the species during these trips have been discussed.

## STUDY AREA AND METHODS

In February, 1987 and in April, 1988 I carried out field studies in two separate areas of the Innerline Reserved Forest (RF) of Cachar district in southern Assam (24° 11' to 24° 31' N and 92° 27' to 92° 53' E). One area is around Gharmura in the western sector in Hailakandi Sub-Division (now a district, since 1st October, 1989). The other is around Jamalpur in the eastern sector in Silchar Sub-Division (sadar). The area consists of low hills, which are the

northern extensions of Mizo (Lushai) Hills. Some of these extensions penetrated much inside Cachar, forming long narrow valleys in between. There are also small flat plains, called *thal* along stream banks.

The vegetation type is of tropical wet evergreen and semi-evergreen. The main tree species of the top canopy and second storey are *Palaquium polyanthum* (kurta), *Dipterocarpus turbinatus* (gurjan), *Artocarpus chaplasi* (cham), *Mesua ferrea* (nageswar), *Cinometra polyandra*, *Eugenia* sp., *Albizia* spp., *Bombax ceiba* (simul), *Duabanga sonneratioides* (ramdala), *Macaranga denticulata* (zaukra), etc. *Melocanna bambusoides* (muli) grows abundantly, especially in the recent and old *jhummed* areas with other species such as *Teinostachyum dulloa* (dolu) and *Bambusa tulda*. At the edge of the hills, in the small *thals* occur patches of wet grassland with *Alpinia allughas* herbs (locally called *tera*). Observations were mostly carried out on foot, although some were made from country boats also. A pair of 20x binocular were used during observations. Whenever the monkeys were near by, observations were made with the naked eye.

## RESULTS

**Distribution:** In India, Phayre's leaf

<sup>1</sup>Accepted October 1993.

<sup>2</sup>Near Gate No.1 of Nehru Stadium, Islampur Road, Guwahati 781 007, Assam.



monkey is found in Tripura (Mukherjee 1982) and Assam (Choudhury 1988). Its distribution pattern shows that it could also be found in Mizoram.

In Assam, Phayre's leaf monkey has a wide distribution in the forested areas of Southern Cachar (including Hailakandi) and Karimganj having its main stronghold in the 1035 sq km Innerline RF (largest RF in Assam). Localities where troops have been sighted and studied by me are Nagorhgena, Damchara (c. 1.5 km west of Nagorhgena), Chorairbakh (c. 7-8 km south-east of Nagorhgena) and Monipuri-chit (near Gharmura). Except Monipuri chit, which is an inhabited village, just outside the reserve forest boundary, all the other localities are inside Innerline RF. I had wondered whether the Dhaleswari River (c. 60-70 m wide at the narrowest) was the eastern limit of its distribution but the sighting at Chorairbakh on the eastern bank of the Dhaleswari river has put the doubts at the rest. Of course, prior to that sighting, reliable reports of occurrence have been received from Sheorartol-tingori, Hatama, etc., areas of Jamalpur sector, all of which are towards east of the Dhaleswari river. Phayre's leaf monkey has also been reported from Bilaipur area of Katakhal RF and Jhalnachara area of Innerline RF.

Regarding their former distribution in Cachar and Karimganj, it can be said that *T. phayrei* occurred up to the Barak River in the north. There is no evidence of its existence north of the river.

The present distribution of Phayre's leaf monkey in Cachar (including Hailakandi) and Karimganj is limited towards north by human habitation, tea gardens and clearings. Towards south, along the Mizoram border, the existing leaf monkey population avoids the immediate vicinity because of heavy poaching by the Mizos.

**Habitat:** Phayre's leaf monkey lives in semi-evergreen habitat with abundant bamboo. It prefers small sheltered valleys, locally called khuchi, where it frequents the lower slopes and the junction of plains and hills. The main vegetation in such junctions include *Macaranga denticulata* shrubs and *Alpinia allughas* herbs. During hot hours of the day, it generally moves to the hills, up to the tops also (less than 100 m elevation in the main study sites in Gharmura area) with dense forest for resting. In Hatama (south of Jamalpur) in the eastern sector of Innerline RF, it has been reported from the evergreen rain forests in low foothills. The bamboo species that grows abundantly in the leaf monkey habitat of the study areas is the muli (*Melocanna bambusoides*).

#### SOCIO-BEHAVIOURAL STUDY

**General socio-behaviour and Food Habit:** In southern Cachar, Phayre's leaf monkey has been observed in trees, among bamboo brakes as well on the ground. In trees, it has been observed from 2 m to more than 13 m above ground. Very tall trees are almost absent in the habitats of all the four troops discovered and studied, mainly because of logging and jhumming. As such, on many an occasion the troops were observed on canopy layers which were hardly 10-15 m high.

Phayre's leaf monkey comes down to ground for feeding and also sometimes during travelling along the hill slopes.

In southern Cachar (Hailakandi area), the monkey is not very shy. I could approach as close as 15 m to some individuals. On many an occasion, some individuals were seen ignoring the presence of local residents.

Like other leaf monkeys or langurs (except the Hanuman langur *Presbytis entellus*) Phayre's leaf monkey is also a strict vegetarian. Its food



in southern Cachar includes the inflorescence of *Macaranga denticulata*, figs of *Ficus hispida*, tender leaves of *Fireus* sp. (Urticaceae), shoots of *Melocanna bambusoides*, besides leaves of various unspecified climbers. Feeding on animal matter or raiding cultivated crops was not observed.

**Territoriality:** The four troops discovered so far in southern Cachar (all in Hailakandi) are divided in such a way by human habitation (encroachments and villages) that there is no scope of any overlapping of territory. A rough assessment of home range of two troops, namely at Nagorhgena and Damchara could be made. Both the troops are very much disturbed by encroachers and jhumias, from almost all sides. So the present home range may not reflect the

Damchara troop also lost more than a third of its range, but due to human barriers all around, the group is still there. In this area, the Reang (a hill tribe) jhumias use the land only for one year. So after a year of hardship, the monkeys will again get back their lost range. The usable areas mentioned above are perhaps used by the troops in different seasons.

**Social organisation:** The monkey lives in bisexual groups. The group size (mean) of the four troops discovered in the study area is 9.0, the range being 5-14 (Table 1). The group at Damchara consisted of one dominant adult male, one adult female with infant, some other adults (perhaps all females), sub-adults (both male and female) and also a few juveniles. The group at Monipuri-chit has no juveniles or infants.

TABLE 1  
GROUP SIZE IN PHAYRE'S LEAF MONKEY IN CACHAR

Date	Locality	Estimated Population
March, 1986 and February, 1987	Nagorhgena, Innerline RF	12-14
February, 1987 and April, 1988	Damchara, Innerline RF	12 ±
February, 1987	Choraibakh, Innerline RF	4+ (6 ?)
April, 1988	Monipuri-Chit	5
Mean Group Size: 9.0 (Range: 5-14)		35-37

actual picture. The first troop in Nagorhgena area had a home range of 37-46 hectares with another 30 hectares of favourable habitat available nearby. The second troop at Damchara had a home range of 62-76 hectares with a further 40 hectares (approx.) of usable habitat nearby.

In the winter of early 1987, the first troop at Nagorhgena area lost about half of its range to jhum cultivators, but being surrounded on all sides by human habitation, they remained within the area. Similarly, in the winter of 1988, the

Sometimes, during foraging one group may split into two or more sub-groups. The Nagorhgena troop was observed in three groups on 21 st March, 1986, the distance between the two extreme individuals was about 0.5 km. The sizes of sub-groups on that day were 4-5, about eight and a solitary individual. The dominant male remained with the larger sub-group of about eight monkeys. There is every possibility that these sub-groups may be treated as different groups in a short or one-day trip. It was after several field trips that I could confirm that for



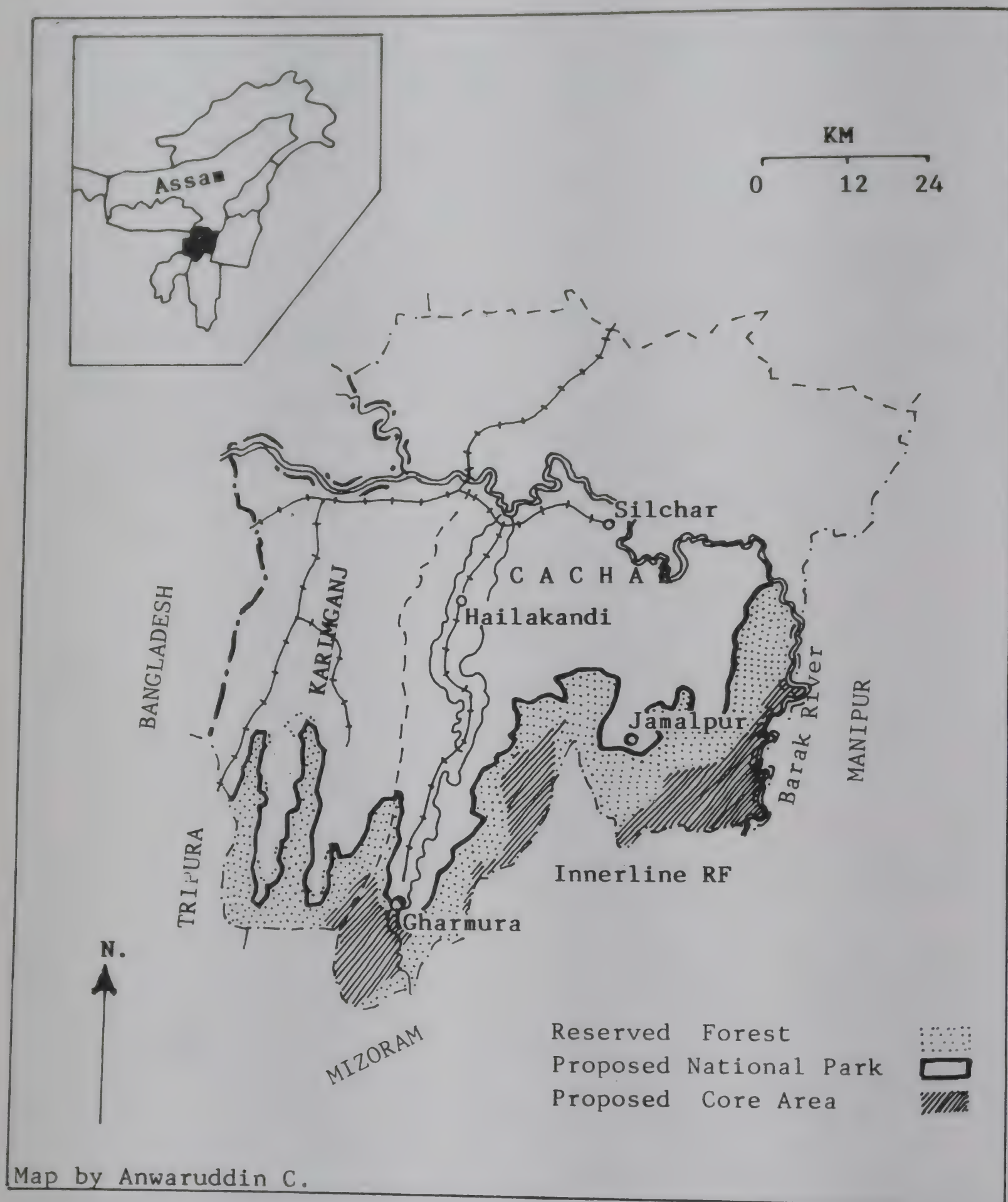


Fig. 1. Study sites and places mentioned in the text.



major part of their activity, all the monkeys remain together.

**Interactions with other primates:** Near Gharmura, Phayre's leaf monkey shares the habitat with the rhesus monkey (*Macaca mulatta*), capped langur (*Trachypithecus pileatus*) and hoolock gibbon (*Hylobates hoolock*). However, contact with the capped langur only could be observed.

On 24 February, 1987, in the afternoon, in a heavily wooded hillock of Damchara both Phayre's leaf monkey and the capped langur were seen resting in the same spot without any antagonistic behaviour to each other. On the same day, in late afternoon, when the same group of Phayre's leaf monkey was feeding, some on the figs of *Ficus hispida*, about half a kilometre away from the forenoon's resting site, a group of capped langurs suddenly appeared, crashing through the muli bamboos. The leaf monkeys stopped feeding and fled leaving the capped langurs feeding in the same area, some even on the figs.

**Vocalisation:** Some vocalisations of *T. phayrei* were heard during the field study, especially when the monkeys were alarmed. The adult males bark loudly at the intruder. The adult male (probably the dominant one) of the Damchara troop barked loudly *ngre-go, ngre-go* at me on my close approach. While it was barking, the other members of the troop vanished among the dense bamboo thickets. On the same day, in the late afternoon, the monkey produced a high pitched vocalisation *kok* at regular intervals of a few minutes. The other members of the group, however, did not panic (as they did on the earlier occasion) and continued feeding.

**Relationship with man:** Phayre's leaf monkey was never reported or observed raiding crops anywhere in the study area and the settlers do not persecute them. There is also no instance

of any pet or captive animals in the study area. Except one male (of Damchara troop), all the other leaf monkeys did not show any aggressive behaviour. The dominant male of Damchara troop barked loudly at me. Near Joynagar and Kaalarhawor (Jamalpur area) in the eastern sector of the Innerline RF, males are reportedly very aggressive towards lone intruders.

**Population estimate:** Phayre's leaf monkey is widely but sparsely distributed throughout southern Cachar (including Hailakandi) and Karimganj. About 1000 sq. km of good and 300-500 sq. km of degraded habitats are available, mostly inside reserved forests. The density worked out is a very low one, 0.8 per sq. km for good habitat and 0.2 per sq. km for degraded forest (Choudhury 1989). Population estimate: 800-900.

## DISCUSSION

Recent studies have shown that Phayre's leaf monkey has a wide distribution in South-East Asia including parts of southern China (Mackinnon and Mackinnon 1987) (Fig. 2). In southern Cachar (including Hailakandi) and Karimganj, although it is widely distributed, populations have become isolated at many places due to haphazard clearing and encroachment. A more detailed survey is required to find out all the groups for conservation action. A survey in Mizoram should be taken up on a priority basis, where it is unlikely to be found in accessible areas due to regular hunting for food.

Hunting by Mizo tribals and habitat destruction continues to threaten the monkey along with other primates. The Mizos relish primate-meat, and are responsible for virtual extermination of primates in the immediate vicinity of Assam-Mizoram border. In the eastern sector, near Jamalpur, they often used to hunt deep inside Cachar area. However,



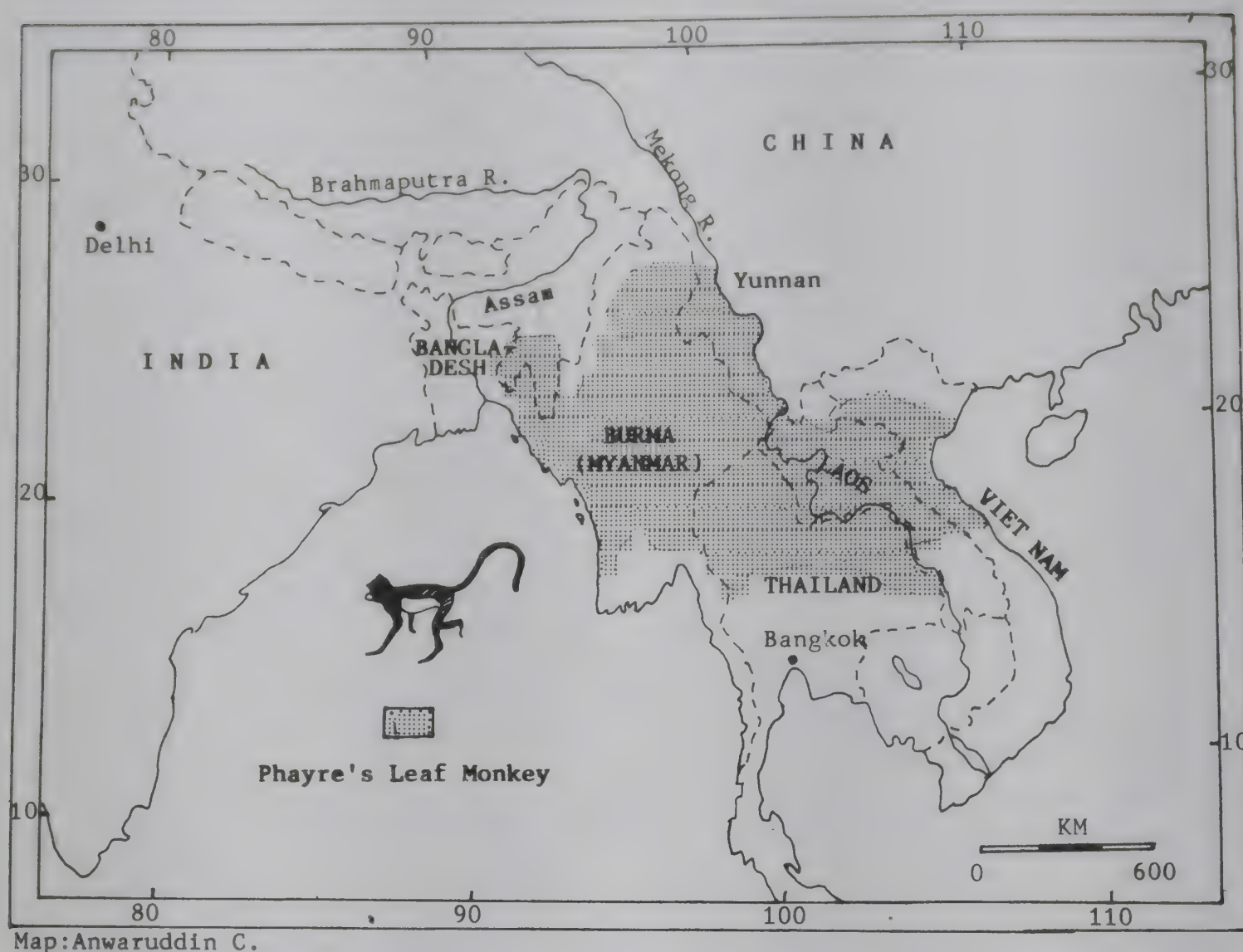


Fig. 2. World distribution of Phayre's leaf monkey. (Source: Own field-work; MacKinnon & MacKinnon, 1987, etc.).

Gharmura and adjacent areas were free from such hunting, because of the presence of some Assam Police Battalion Camps, who used to apprehend any Mizo carrying arms. But after the signing of Mizo Accord between the Government of India and the underground MNF (Mizo National Front) guerrillas in 1986, the situation has worsened. The Mizos are now making frequent trips to Gharmura area and are killing all species of primates including Phayre's leaf monkey, capped langur, hoolock gibbon, rhesus monkey, pigtailed macaque, etc. They move with vehicles and arms, and move deep inside Assam territory.

In one recent case, a group of Mizo

poachers camped at the house of a Tipra tribal family in Jacobpur forest village, near Gharmura, sometimes in January-February, 1988. They returned to Mizoram with a "jeep-load" of primates. Some Mizo traders who come by country-boats through the Dhaleswari River, also carry gun with them mainly for hunting primates.

I have brought this to the notice of the Chief Minister of Assam, who was then holding the Forest portfolio also. Although he instructed the Chief Conservator of Forests (Wildlife) to enquire and take appropriate action, I did not hear of any further development in this regard.

Since February, 1986, I have travelled



through many of the forested areas of Assam in search of primates, but the Innerline RF, especially areas around Gharmura appeared to be the richest. Both in number of species and easy accessibility to rare primates, this area topped all others. Sighting of at least four species including the rare Phayre's leaf monkey, hoolock gibbon, capped langur and rhesus monkey is almost assured. If luck permits, one may also come across the slow loris, pigtailed macaque and Assamese macaque.

The main reason for which the leaf monkey habitats of Cachar, Hailakandi and Karimganj are destroyed are *jhum* or slash-and-burn shifting cultivation, monoculture forest plantation, encroachments and the 'bamboo harvesting' by the large paper mills of Panchgram. Although the bulk of leaf monkey's range is within reserved forests, unauthorised *jhum* cultivation mainly by the Reang tribes is opening up large forest areas. Such cultivation in the area is going on from time immemorial. However, local growth of population, influx of more Reangs from Tripura and corruption of local officials have worsened the situation.

Some fine primate habitat with excellent evergreen forest are destroyed annually by the Forest Department for the plantation of teak (*Tectona grandis*).

Panchgram Paper Mills (now in Hailakandi district) having a capacity of one lakh ton per year is among the largest paper mills of Asia. A labour force of several thousand operates in the forests for collection of bamboo. It may be mentioned here that the whole of Phayre's leaf monkey habitat of Karimganj and southern Cachar (including Hailakandi) has been leased out by the Government of Assam to the Hindustan Paper Corporation for 30 years.

There are also other factors like illegal felling and bamboo collection, presence of Forest Villages inside the reserved forests,

construction of Gharmura-Bhairabi railway through the Innerline RF, Gharmura-Bhairabi road, Jamalpur-Saiphai road, and the proposed road near Gharmura along the west bank of the Dholeswari River. The last mentioned road, if constructed will be very harmful to the primates as a whole.

#### CONCLUSION

1. An area of 1670 sq. km should be declared as "Dholeswari National Park" of which 30 sq. km should be designated as the Core Area. The Park will cover the bulk of the reserved forests of southern Cachar (including Hailakandi) and Karimganj (Fig. 1) (Choudhury 1989).

2. Hunting by visiting Mizos from Mizoram must be stopped immediately by strictly enforcing the Indian Wildlife (Protection) Act, 1972. Checkgates manned jointly by Assam Police Battalion and the Wildlife staff of the Forest Department should be set up on Gharmura-Bhairabi Road at Bhairabi and Ramnathpur, on Jamalpur-Saiphai Road at Saiphai, and at Goduldor on the Dholeswari river.

3. *Jhum* cultivation should be controlled as complete elimination is a remote possibility. The core area should be made free of *jhum* at first. Influx of fresh *jhum*iyas from Mizoram and Tripura should also be stopped.

4. All the fresh encroachers be evicted while the old ones may be allowed to stay. But none should be in the core area. Similarly, the Forest Villages falling under the core area should be relocated outside.

5. The "bamboo harvesting" of the Panchgram Paper Mills should be stopped in the proposed core area. In the buffer zone the same should be under strict vigilance.

6. The proposed road along the west bank



of the Dhaleswari river near Gharmura which is to cater only the contractors and bamboo-collectors of the paper mills should be shelved immediately.

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# DISTRIBUTION AND GENERAL ECOLOGY OF THE SARUS CRANE (*GRUS ANTIGONE*) IN KEOLADEO NATIONAL PARK, BHARATPUR, RAJASTHAN<sup>1</sup>

N.K. RAMACHANDRAN AND V.S. VIJAYAN<sup>2</sup>  
(With seven text-figures)

**Key words:** *Grus antigone antigone*, annual cycle, local movement

Information on the ecology of the Sarus crane *Grus antigone antigone* from 1984 to 1985 and on their breeding population from 1980 to 1988 at Keoladeo National Park are presented here. Aspects such as population, distribution, habitat preference, breeding, roosting behaviour, local movements and annual cycle are covered. The park supports two types of population; resident and floating. The population shoots up to  $\pm 250$  in summer and, decreases to  $\pm 24$  during winter which constitutes the breeding population. The number of birds breeding in an year is related to the waterspread area and the timing of the monsoon. Over the last ten years the number of breeding pairs has shown a declining trend. The fledgling success was 20% and 37.5% during 1984 and 1985 respectively. The massive congregation in summer is due to the drying up of waterbodies outside the park. The possible reason for the origin of flocking and the conservation strategies are also discussed.

## INTRODUCTION

The Indian race of the Sarus crane *Grus antigone antigone* is distributed mainly in the northern part of India (Ali and Ripley 1969). Gole (1989) recently carried out a survey to estimate the distribution of this species in the range mentioned by Ali and Ripley. Although it is a wetland species, it has developed a marked flexibility in its habitat requirements. Hume (1868) when comparing the habitat of the Siberian crane to others says that Sarus crane is able to utilize the dry land too. Today this species survives not only because of the religious sentiments of the people as opined by Ali and Ripley (1969) and Archibald *et al.* (1981) but also because of its greater adaptability towards the fast changing environment.

The ecology of the species is little known. Previous works on this species include qualitative description of their distribution, diet,

habit and habitat and some quantitative information on morphometry of body and eggs (Ali & Ripley 1969). Study on the post-natal imprinting of vital commands (Ali 1958), and a stray note on their nidification (Mosse 1910). Recently there has been an increased interest in their ecology (Ali and Vijayan 1986, Gole 1983, Vyas and Kulshrestha 1989, Kulshrestha and Vyas 1989, Parasharya *et al.* 1989, Singh and Khan 1989, Sharma 1989, Desai 1989).

Among the four species of cranes reported from the study area, Keoladeo National Park (Abdulali and Panday 1978) the Sarus crane is resident and the rest are migratory. Among the migratory species only the Siberian crane is a permanent visitor. The Common crane and the Demoiselle crane are occasional visitors. In the present study the distribution, population, local movements, habitat preference, intraspecific relationship and breeding biology of the Sarus crane are described. An in depth study was conducted over a year 1984-85 and the breeding population was monitored up to 1988.

## STUDY AREA

The study was carried out in the Keoladeo

<sup>1</sup>Accepted July 1992.

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National Park situated between  $27^{\circ}7.6'$  to  $27^{\circ}12.2'$  N and  $77^{\circ}29.5'$  to  $77^{\circ}33.9'$  E, two kilometres south of Bharatpur city; 38 km south west of Mathura and 50 km west of Agra. The total area of the park is 29 sq. km out of which 8.5 sq. km are inundated from Ajan bund during the monsoon and the water level gradually recedes and the area dries up in summer leaving

#### METHODOLOGY

The population was estimated by counting the birds directly covering all the blocks of the park. Two censuses were made each month. The location of sighting was plotted on a map to give an idea of the pattern of distribution. During summer, when most parts of the park and the neighbouring areas were dry, the Sarus gathered

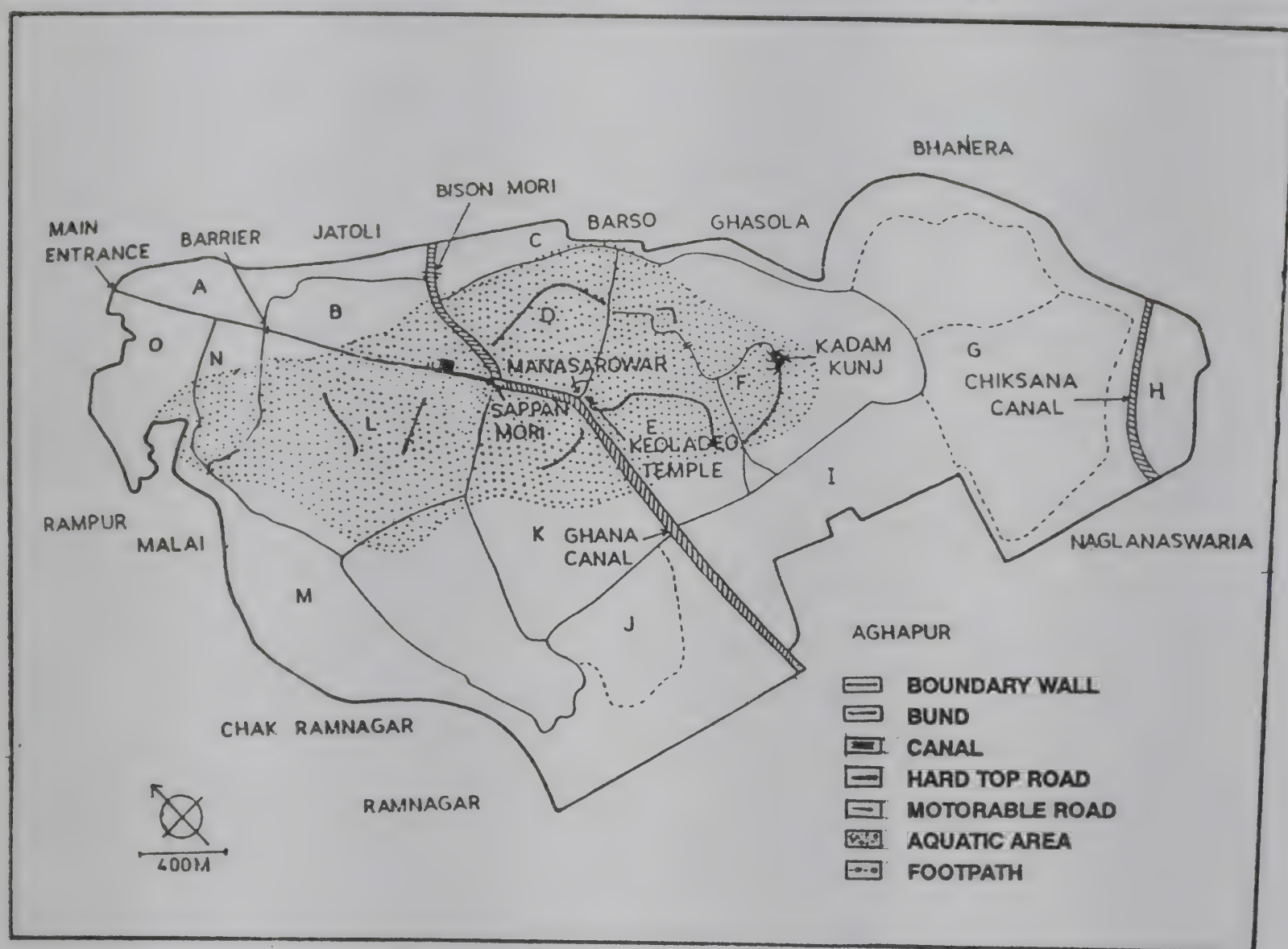


Fig.1. Map of Keoladeo National Park.

some pools in deeper areas. The park is enclosed by a boundary wall and is surrounded by agricultural fields. The whole area of the park is divided into blocks of varying sizes by dykes (Fig. 1). Some of the land areas form good grasslands and the rest is deciduous thorny scrub jungle.

at the pools both in the morning and evening. Habitat preference was recorded by regular survey in different blocks noting each sighting along with the type of habitat. Food and feeding habits were studied by visual observation. Attempts were also made to collect and analyse samples from their feeding areas. Similarly,



droppings of the bird were collected and analysed whenever possible.

# RESULTS AND DISCUSSION

**Population and distribution:** The population of the Sarus crane remains almost constant inside the park except during spring and summer, i.e. March, April, May, and June. From the end of March, birds from neighbouring areas gather in large number and the population shoots

floating.

There is a marked difference between the distribution of Sarus crane in summer and winter (Figs. 3, 4). The monsoon-winter distribution of Sarus is determined by the waterspread and breeding and, summer distribution by the extent of drying up of park and adjacent areas. Inside the park they move from place to place as the water dries up. During the breeding season most of them are confined to the waterspread areas of the park.

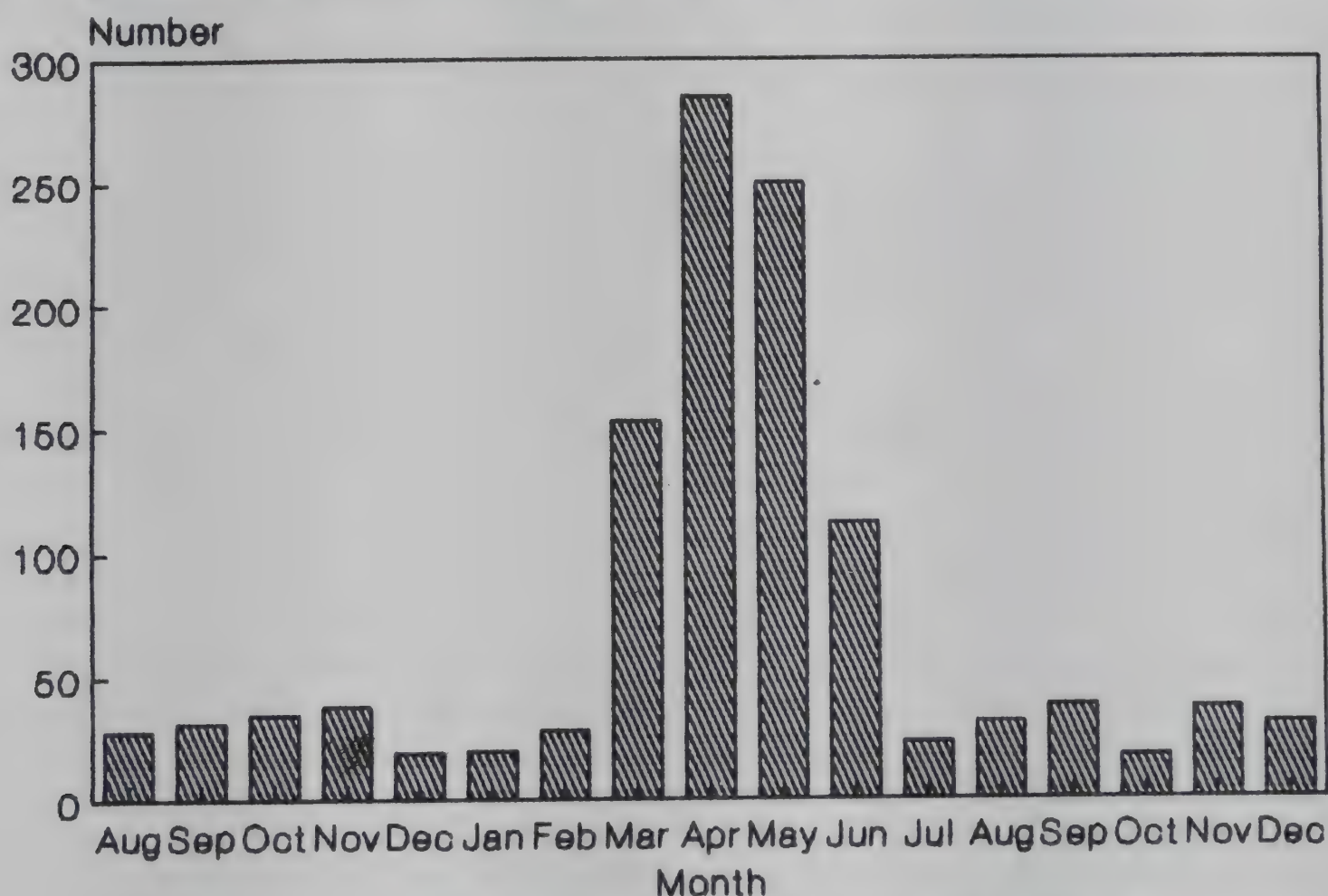


Fig. 2. Population of the Sarus crane in Keoladeo National Park (1984-1985).

up to 250 (Fig. 2). This influx is due to the drying up of waterbodies in the adjacent areas. During summer most of the birds leave the sanctuary for feeding outside, while some pairs remain inside throughout the year. These may be the breeding pairs of the park. Hence it is hypothesized that there are two populations inside the park, one resident and the other

## BREEDING

**Breeding population:** In 1986 with the onset of monsoon and the subsequent flooding of the park, the massive summer congregation of Sarus dispersed leaving only  $\pm 24$  birds inside the park, these constituted the breeding population, a very low figure compared to



TABLE 1  
BREEDING POPULATION OF THE SARUS CRANE

Year	No. of pairs	Density* per sq. km	Source
1969	27	0.9	Walkinshaw (1973)
1980	16	0.56	Belinda Breeden (Pers. communication)
1982	14	0.49	Ali and Vijayan (1986)
1984	3	0.11	Present study
1985	11	0.38	"
1988	10	0.34	Lalitha Vijayan (Pers. communication)

\* Density for the total sanctuary.

previous years (Table 1).

The extent of flooding by the incoming water appears to be one of the factors determining the size of the breeding population (Table 2). In 1984 when the water received by the park was less, only three pairs bred. Hence, the quantity of the annual water supply to the park plays a major role in determining the size of the breeding population, provided the timing of the monsoon is normal.

**Breeding Season:** The main breeding season during 1982 to 1985 was from August to October. Ali and Ripley (1969) report the breeding season to be from July to October while Walkinshaw (1973) recorded it as from June to March with a peak during July, August and September. In the present study a sub-season was recorded during February to March when only three or four pairs bred. Vyas and Kulshrestha (1989) also reported a sub-season from February to April in Kota area, about 200 km from Bharatpur and state that the number of

pairs breeding during this season was low and thus confirms the existence of a sub-season. However, breeding was not successful during this season in most of the years. In 1985 there was no nesting during the sub-season whereas eight pairs bred in 1986 when there was more water remaining in summer. The two possibilities for having two breeding seasons are: (1) there may be two populations which might be breeding in two different seasons, (2) some of the birds might be having a second brood as suggested by Serventy (1939). However, This could not be checked in the present case as the birds could not be colour-marked and identified individually.

**Nesting site:** Usually the nest is built on a slightly raised area in the submerged portions of the park. The nesting site is invariably surrounded by water, the depth of which varied from 15 cm to 1.5 m. During the main breeding season the nests were located quite far from the dykes; whereas during the sub-season some of them were quite close to the dykes. Nine out of the eleven nests of 1985 were on thick grass patches and only two were on *Acacia* mound. The nesting site was selected in such a way that one or two sides of the nests have open expanses of grasses which may be for detecting predators at a distance. Those nests which were placed on thick grass were completely surrounded by sprouting grasses like *Paspalum distichum* and hence the incubating bird could be detected only when it raised its head. Availability of shallow water areas near nesting site appeared to be one of the major factors determining the selection of site. In all the nests studied, shallow water areas were available within 100 to 150 m where the parent birds foraged.

**Nesting material:** Nesting materials varied from nest to nest and was dependent on the nesting site. They seldom bring material to the nest; instead pull out whatever material was



TABLE 2  
BREEDING PAIRS OF THE SARUS CRANE AND  
THE ANNUAL QUANTUM OF WATER RELEASED  
INTO THE PARK

Year	Number of pairs	Water released in million m <sup>3</sup>	Monsoon *
1980	16	14.56	S
1982	14	14.71	S
1983	NA	14.57	S
1984	3	9.79	F
1985	11	15.32	S
1986 **	8	0.02	F
1987	0	6.77	F
1988	10	13.73	F

\* S = Success; F = Failure; \*\* = eight pairs bred in summer; NA = not applicable.

available around the nest location.

Of the eight nests intensively studied, except for two, the rest were made of *Paspalum distichum*, the most common grass in the park. The nest in block 'B' was on a mound with a thin layer of *Paspalum distichum*. The nest in block 'J' was made of *Sporobolus helvolus*, while in block 'LW' it was of dry *Acacia* twigs and *Paspalum distichum*.

**The nest:** The nest was usually a pile of grass on a mat of *Paspalum distichum*. The grass was just piled up from the surrounding area within 1 to 1.5 m radius. The base of the nest is broader. There is a slight depression on the top, obviously for the eggs. The grass pile reaches 70 cm high from the surface of the water. The grass was loosely placed. No inner lining was noticed. The nest which was made of *Acacia* twigs and *Paspalum distichum* was neatly interwoven and

had a circular shape.

**Nest building:** Both the male and female remained in the 'prospective' nesting site for almost a month before the nest building began. In the initial stages of nest building very little time was spent on construction. Both sexes participate, pulling out the surrounding grass by a lateral movement of the neck and heap them. They seldom moved. After pulling the grass it turns the neck towards the heap of grass and throws the material. The process is repeated. In the initial stages the process is slow with intervals for feeding. During this period the birds do not go for feeding. Strengthening of the nest continues even after egg laying. In block 'N' they used the suspended and floating dead grass and stems for strengthening the nest. Another interesting feature noticed in the building of the nest in block 'N' was that three adult birds (2 males and 1 female) participated. One bird pulled out the nesting material and threw them to the next one who was standing by the side of the nest which then collected and put them on the nest. The participation of a third individual in the nest building is interesting. The relationship is not clear and after the fourth day of incubation the 'extra' male disappeared from the scene.

**Territory:** Territory is well defined. The pairs remained in the same area throughout the year, except in summer. However, during non-breeding season they cover larger areas for foraging. The breeding territory ranges from 0.068 sq. km to 1 sq. km. Usually the nest is built on one corner of the territory. Of the eight nests studied, only one was near the centre. Most of the territories had two zones: a shallow area where the parent bird fed and a deeper zone in the immediate vicinity of the nest where the adult never went for feeding during incubation. It appears that this deeper area is preserved for the young. By the time the egg hatches and the



chicks are out, this area becomes shallower and the parent bird with the chicks feeds there. Till the chicks are about a month old, the water depth remains deep enough to prevent predators. The incubating birds, in most cases have an eye on the nest while feeding. This again suggests that the shallower areas for feeding have to be within 100-150 m from the nest.

**Clutch size:** The clutch size was two in nine and one in two in the eleven nests studied during 1984 to 1985 (Table 3). Comparison of the present clutch data with that of Walkinshaw (1973) shows a reduction in clutch size (Table 3). Such a trend was noticed in whooping crane also (Kuyt Ernie 1981). We suggest that this reduction of clutch size is probably related to the degradation of the habitat.

TABLE 3  
CLUTCH SIZE

Clutch size	Present study		Walkinshaw 1973	
	No. of nests	% of total nests	No. of nests	% of total nests
1	2	18	4	3
2	9	82	126	95
3	-	-	2	2

**Incubation:** The incubation period was 33 days in the one case that could be observed. Ali (1927) quoting from the memoirs of Jehangir and from another source (Alipore zoo: Lahiri) states that the period is 34 and 28 days respectively. Both the sexes incubate. In the initial stages of incubation, while one parent incubated the other remained near the nest, engaged in strengthening the nest. While changing over for incubation there was no rituals except at one nest. The incubating bird gets up

and moves a little, when the mate arrives at the nest. It moved away for feeding only after the partner sat on the nest. Only in one case did the incubating bird move about 15 m away for feeding before the other one came to the nest. Sometimes it silently walked away and, at times hopped or even flew. Similarly when taking over incubation, sometimes, they flew to the nest, but most of the time walked in. In one case the bird which was to relieve came about 50 m from the nest. The incubating bird then stood up and moved towards it and both joined to give a duet and display. In the nest in block 'N' prolonged unison call and display were observed before the exchange of duty. It is presumed that such a display may strengthen the pair bond which was under confusion as two males were found at the nest.

The display and dances were different from those at the beginning of the breeding season. Here the birds did not prance; only lowered the neck and flapped the wings. The duration was also short.

**Behaviour of incubating bird:** Continuous observations were made on the incubation for 10 hrs from 0700 hrs to 1700 hrs. The male spent more time in incubating than the female; 369 min. and 214 min. respectively. Change over took place only twice. It is doubtful whether there was a change over before 0700 hrs and another after 1600 hrs. The average time spent in 'duty' change over was 3 min.

At one nest the incubating female stood up 9 times for arranging the eggs and nesting material and for preening, whereas the male did so 14 times. While incubating, the bird very rarely slept, keeping the beak on the shoulder. Often it lifted the head up to look around. Once the male on duty was out for 35 min. in the vicinity of the nest and fed occasionally.

The incubating bird did not react to the



presence of jacanas, pied myna and crow near the nest. However, at the approach of man, the incubating bird quietly moved off the nest and stood and watched. When the person neared the nest it flew away in a low noiseless flight landing close enough to watch the nest. When the person left the nest, it immediately returned.

**Hatching:** The actual hatching could not be observed. However, in one case, when the observer went for a routine check, the beak of the chick was seen protruding out through the broad end of the egg.

**Parent-chick relation:** The chicks began to move with the parents on the same day of hatching and they were fed by the parents. The food material was kept in the beak crosswise and then offered to the chicks which pecked at it. In one case the parent and the chick used only the *Acacia* mounds, and moved from mound to mound. Food was collected from the slope of the mounds.

When there are two eggs in a clutch and if only one hatched and if the parent continued incubating, the chick moved around within a radius of about a metre from the nest. It often nestled under the wing of the incubating bird. Sometimes it got in through the shoulder region while in some cases from behind. At times the incubating parent pulled out some material (apparently *Ipomoea* stem) and the chick pecked at it. However, the chick never went with the non-incubating parent for feeding. It was not clear whether the parent picked up insects from the nest and offered them to the chick.

The juvenile remained with the parents. At times the parents fed them. Once a water snake was collected by the parent and cut into two, while the juvenile picked it up from the beak of the parent. The juvenile continued to be with the parents, till summer, but after the summer flocking, the first year bird could not be located.

**Breeding success:** Altogether 14 nests were

recorded from 1984 August to 1985 October, covering two major breeding seasons. There were three nests in 1984 and 11 in 1985. During 1984 only one out of the 5 eggs hatched; the breeding success being 20%. In 1985 altogether 16 eggs were laid and six hatched, i.e. 37.5% (Table 4).

TABLE 4  
BREEDING SUCCESS

Years	Total eggs laid	No. of chicks fledged	% of chicks fledged
1984	5	1	20
1985	16	6	37.5

The fewer number of eggs laid during 1984 might be due to the failure of the monsoon and the consequent drying up of the park for a brief period. In 1985 the monsoon arrived on time and the water depth was also higher than that of 1984, making the biotic environment more congenial for nesting (Table 2). The higher nesting success may be due to this factor. The nesting started much later in 1984, by the end of August, and the nesting period was also shorter, whereas in 1985 it started by the beginning of August.

**Hatching success:** Of the sixteen eggs laid in 1985, only seven hatched out giving a hatching success of 44%. Various factors affected hatching. In two cases the pairs disappeared owing to human disturbances; in one case feral cattle trampled on the eggs, and in two cases where the clutch size was two, two eggs disappeared. The cause of the disappearance of the eggs is not known. It is interesting to note that in one nest when one egg was attacked and broken by crows, one of the parents ate the broken egg.

**Fledgling success:** Of the seven chicks that



hatched out six were successfully reared giving a Fledgling success of 86%. The higher Fledgling success may be due to the intensive care by the parents.

**Food and feeding habit:** It was very difficult to identify all the food items visually. However, the following materials were taken; rhizomes of *Nymphaea* sp., *Scirpus tuberosus*, *Eleocharis plantaginea*; insects and seeds picked from the tips of the grasses; molluscs and snakes. As there were changes in their habitat requirements at different seasons and different times of the day their diet also varied between habitats. In the wetland they fed mainly on the rhizomes of the above mentioned plants and also on molluscs. In dry grassland they fed on insects and seeds. During summer they move out into the villages for feeding on wheat (guano contained wheat husk). The feeding strategies also varied among habitats. They employed probing technique in wet areas, and pecking in dry lands.

**Roosting:** The roosting behaviour was studied intensively during summer and winter. During winter they roost in pairs or in family parties. The pairs seen between December 1984 and February 1985 are shown in Fig. 4. They roost about 20 to 40 m from the dykes. The roosting site was a grass patch with about 30 to 40 cm deep water. In two cases they were found roosting along with the Siberian cranes. In summer the pattern was totally different (Fig. 3). From the end of February Sarus started flocking inside the park, as many as 98 were found in block 'L'. In April when most parts of the park dried up the birds started flocking in large numbers. The maximum number noticed was 226 in block 'D' (Table 5).

The shifting of roosting place corresponded in general with the availability of water (Table 5). The birds dispersed by the end of the first week of June which synchronised with the pre-

monsoon showers.

**Roosting behaviour:** The birds flock at the roosting site from sun set, 1845 to 1950 hrs during summer. The flocks continued arriving till 1930 hrs. The birds which arrived early fed from the roosting site by probing into mud. They made unison as well as location call and hurdled together in water. They wake usually, at

TABLE 5  
NUMBER OF SARUS ROOSTING IN THE PARK  
DURING SUMMER 1985

Date	Blocks				
	E	LW	D	K	LS
19 April	-	10	194	2	15
22 April	-	10	209	-	-
23 April	4	10	226	-	-
29 April	-	10	185	-	-
06 May	6	-	188	-	-
13 May	-	17	-	-	-
25 May	183	-	30	-	-
03 June	58	-	103	-	-
08 June	20	-	35	-	-
15 June	19	-	69	-	-
26 June	6	-	14	-	-
28 June	6	-	4	-	-

least 30 to 45 minutes before sunrise. All except a pair or two take off in small flocks in different directions. The remaining pairs stay till sunrise and then move off and start feeding. These appear to be the pair, resident in the block. The pairs from adjacent blocks also leave the roosting site.

**Movement pattern:** During summer, the



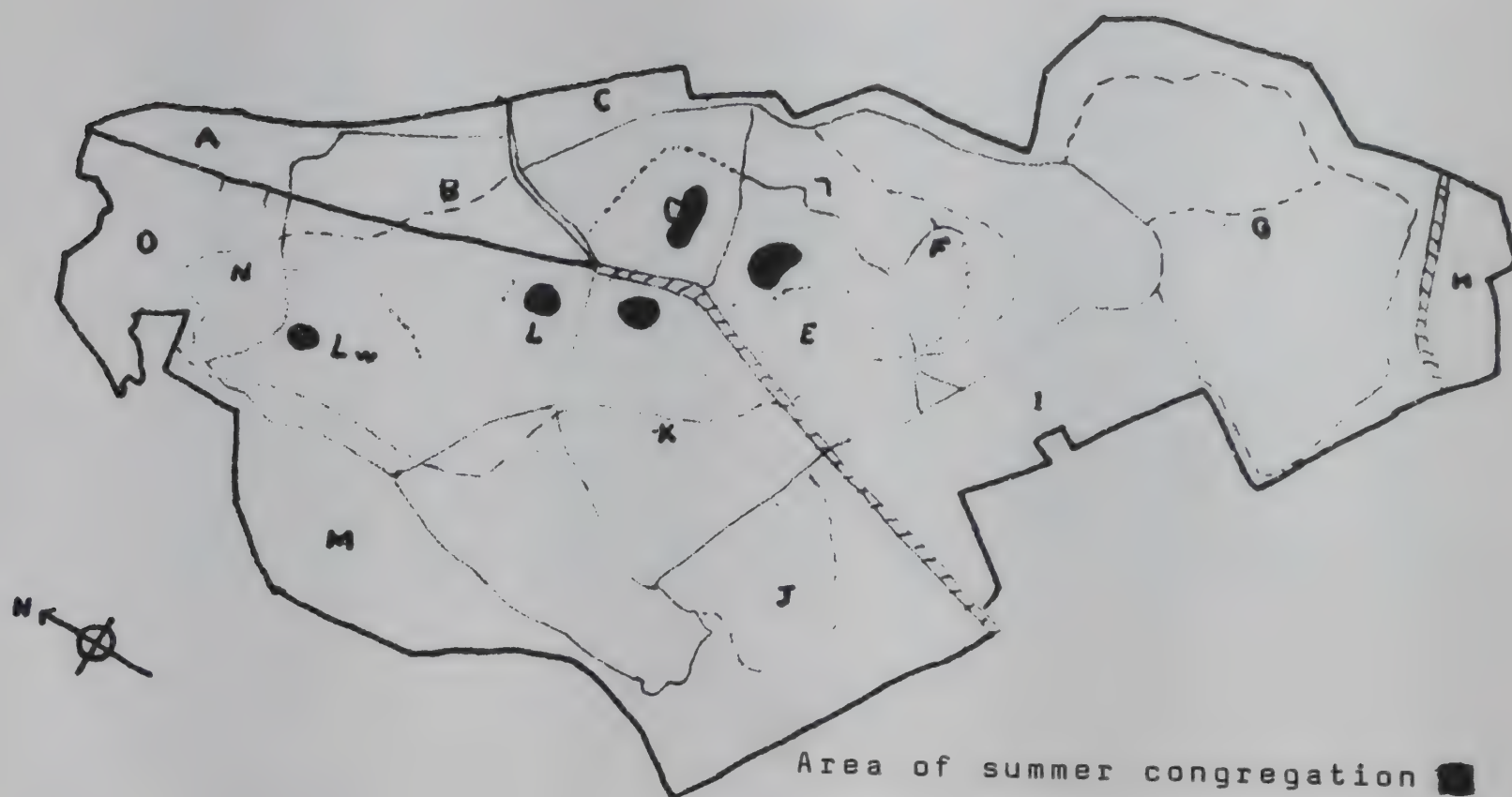


Fig. 3. Distribution of Sarus crane in summer.



Fig. 4. Distribution of Sarus crane in winter.



birds leaving the roosting site early in the morning return after about three hours and remain inside the park up to 3 p.m. They leave again and return for roosting as observed by Walkinshaw (1973). They forage in the wheat stubble of the villages as the season synchronized with the harvesting of wheat. Guano analysis also showed the presence of wheat husk. When they were inside the park, they took rest and probably also feed on molluscs, by probing into the mud. Mud samples from the area contained large number of molluscs. A population of about 30 birds remained inside the park throughout the day.

**Habitat preference:** The habitats were divided into five major groups. The bird sightings in each habitat were recorded along with the time and activity at the time of observation. The observation time was distributed equally among all the habitats as far as possible. Altogether 8401 sightings were made. The study was conducted from August 1984 to August 1985.

The most utilized habitat for the entire period of study was moderately wet grassland followed by pools (Fig. 5). However, monthly and daily variation in the habitat utilization was noticed (Fig. 6) as in the case of Sandhill cranes (Anon. 1981). The pools were used mainly

during the summer. The percentage of birds using pools was high because of the summer flocking of Sarus in pools. From August to January they preferred flooded and moderately wet grassland. During May, June and July when flooded grassland and moderately wet grassland were absent in the park, they resorted to dry grassland and pools.

Moderately wet grassland and flooded grassland were used almost in the same proportion for feeding during breeding season and hence, these habitats are critical for the survival of the species. In moderately wet grassland the soil is wet but not inundated. Hence the water management for the crane should be such that a portion of the aquatic area should be kept shallow while a portion is inundated with about 25-30 cm of water. The pools are very essential in summer, as they attract a large number of birds for flocking which certainly provide facilities for feeding and mate selection. They also feed on molluscs from the mud during this period, which satisfies the physiological requirement of more calcium for forming egg shell in the approaching breeding season. Therefore, the pools have a survival value for the cranes.

**Annual cycle of the Sarus crane and conservation recommendations:** The study shows the annual biological cycle of the Sarus crane is closely interwoven with the seasonality of the environmental regime (Fig. 7). Since the park seems to be the known last resort for the cranes for water in summer (Johnsgard 1983) they aggregate in large numbers near the pools of the park. Towards the end of this season mating begins. With the onset of monsoon and subsequent flooding of park most of them disperse, leaving around 25-30 birds in the sanctuary which form the breeding or resident population. They are territorial during this period. All chicks are out by October-November,

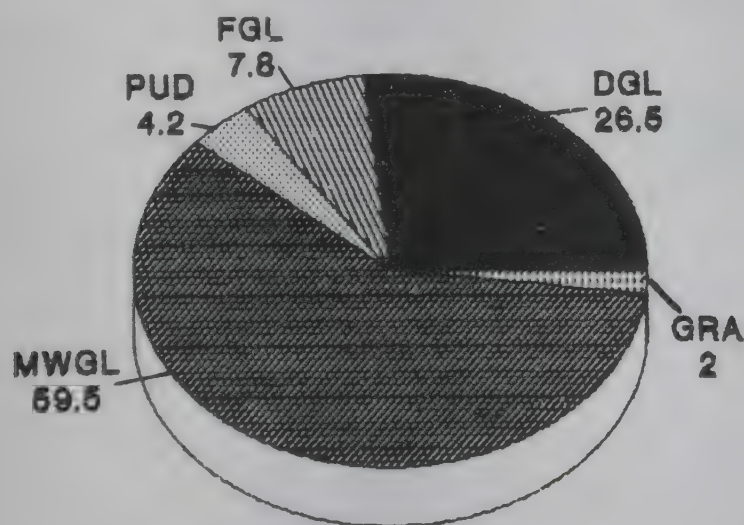


Fig. 5. Habitat preference of the Sarus crane (Percentage frequency).



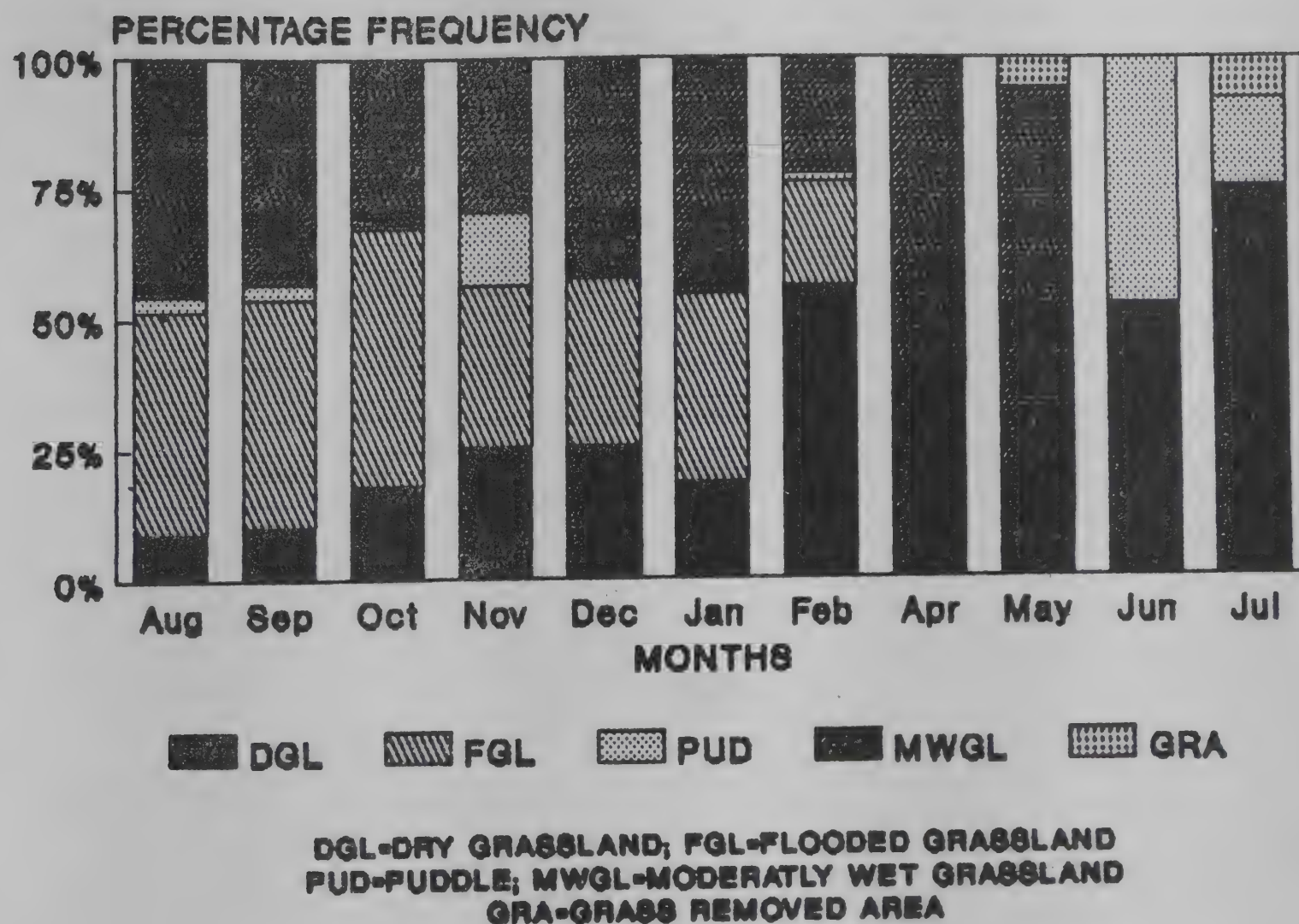


Fig. 6. Monthly variation in the habitat preference of Sarus crane.

and if the conditions are favourable during January-February, a few pairs nest and produce chicks. Again the park dries up leaving some pools where the cranes from the neighbouring areas congregate making them non-territorial.

The Keoladeo National Park is an excellent example of an insular habitat separated from the surrounding areas which have been transformed to agricultural land and human settlements. Although the sarus crane seems to have developed adaptability to such anthropogenic pressures, there must be a maxima beyond which they may not be able to adapt. Citing example of the three forest blocks of state Sao Paulo in Brazil, Yablokov (1986) asserts that the effect of this type of insularisation first triggers off a reduction of those species with low population density. The density of breeding population of

sarus crane for the last eight years shows a declining trend. The mammoth flocking of this species in the park may be one of the results of the insularisation process under way over many years. The deleterious effect of habitat insulation on the bird is compounded by the increased use of pesticides all around the park (Muralidharan 1992). The habitat is again threatened by the industrial effluents in the waterbodies which are vital for the survival of the sarus crane. A conservation programme for the sarus crane has to be developed in the light of these factors.

#### ACKNOWLEDGEMENTS

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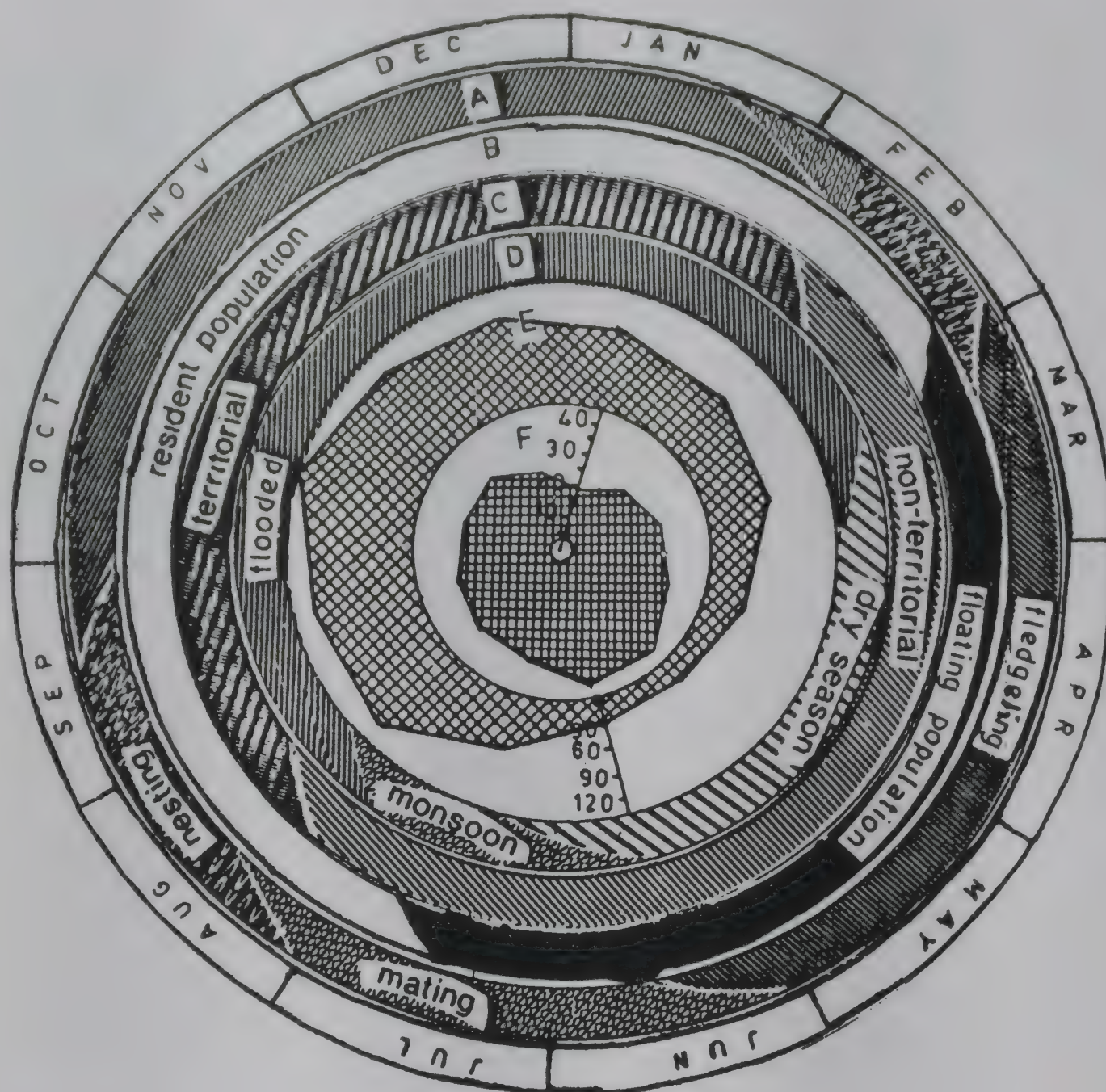


Fig. 7. Annual cycle of Sarus crane. A. Reproductive activities; B. Population characteristics; C. Social pattern, D. Environmental changes; E. Average monthly depth; F. Average monthly temperature.

U.S. Fish and Wildlife Service and the Ministry of Environment, Government of India.

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# THE BATS OF WESTERN INDIA REVISITED<sup>1</sup>

## Part 2

P.J.J. BATES, D.L. HARRISON<sup>2</sup> AND M. MUNI<sup>3</sup>

(With a plate and six text-figures)

(continued from Vol. 91 (1): 15)

### Family EMBALLONURIDAE

#### ***Taphozous longimanus* Hardwicke, 1825 - Long-winged Tomb bat**

*Taphozous longimanus* Hardwicke, 1825:  
Transactions Linn. Soc. Lond., 14: 525.  
Calcutta, Bengal, India.

**External characters:** This is a small species of *Taphozous*. It is distinguished from *T. melanopogon* by its shorter forearm which usually does not exceed 62 mm and by the presence of a well developed gular sac and pectoral gland in the male; in the female there is a rudimentary fold of skin. In both sexes, the chin is essentially naked. In contrast to both *T. melanopogon* and *T. perforatus*, the wings are attached to the ankles and not to the tibiae. The pelage colour ranges from cinnamon brown to reddish brown to black, sometimes speckled with paler hairs; the darker individuals are usually females. The belly tends to be of a lighter hue than the upper surface. The fur on the dorsal aspect of the body extends onto the wing membranes for about half the length of each humerus and femur; in *T. melanopogon*, the comparable figure is about one third. The membranes are dark brown with the radio-metacarpal pouch of each wing only moderately developed. This species has a strong, characteristic smell.

**Cranial and dental characters:** The skull is closely similar in size and morphology to *T. melanopogon*. It has the typical *Taphozous* characters of premaxillae represented by nasal branches only; well developed postorbital processes and deep basisphenoid pits. It may be distinguished from *T. perforatus* by its average larger size; it is both longer and broader and by the shape of the anterior border of the mesopterygoid space; it is V-shaped in *T. longimanus* but distinctly U-shaped in *T. perforatus*. The basisphenoid pits are also better developed than those of *T. perforatus*, with an antero-posterior diameter, measured at the septum, of some 3.8 mm as opposed to 2.6-3.2 mm in *T. perforatus*. There is no clear-cut character that discriminates between the skulls of *T. longimanus* and *T. melanopogon*, although the basisphenoid pits of *T. melanopogon* do appear to be the best developed of the small local *Taphozous* species. The mandible is without special features. The dental characters are typical of the genus (Fig. 5).

**Dental formula:**  $i\ 1/2\ c\ 1/1\ pm\ 2/2\ m\ 3/3$   
 $= 30$ .

**Measurements:** Based on specimens of both sexes from throughout the Indian subcontinent.

**Ecology:** *Taphozous longimanus* has a wide habitat tolerance and is found in divergent climatic regions ranging from arid areas in Gujarat to humid climes in Sri Lanka and Burma. Its diurnal roosts include caves, old buildings, wells (Brosset 1962a); hollow banyan and peepal trees (Sinha 1986) and the crown or trunk of palm trees (Phillips 1924, Sinha 1986).

<sup>1</sup>Accepted September 1992.

<sup>2</sup>Harrison Zoological Museum, Bowerwood House, St. Botolph's Road, Sevenoaks, Kent, TN13 3AQ, England.

<sup>3</sup>Bombay Natural History Society, Hornbill House, Shaheed Bhagat Singh Marg, Bombay 400 023.



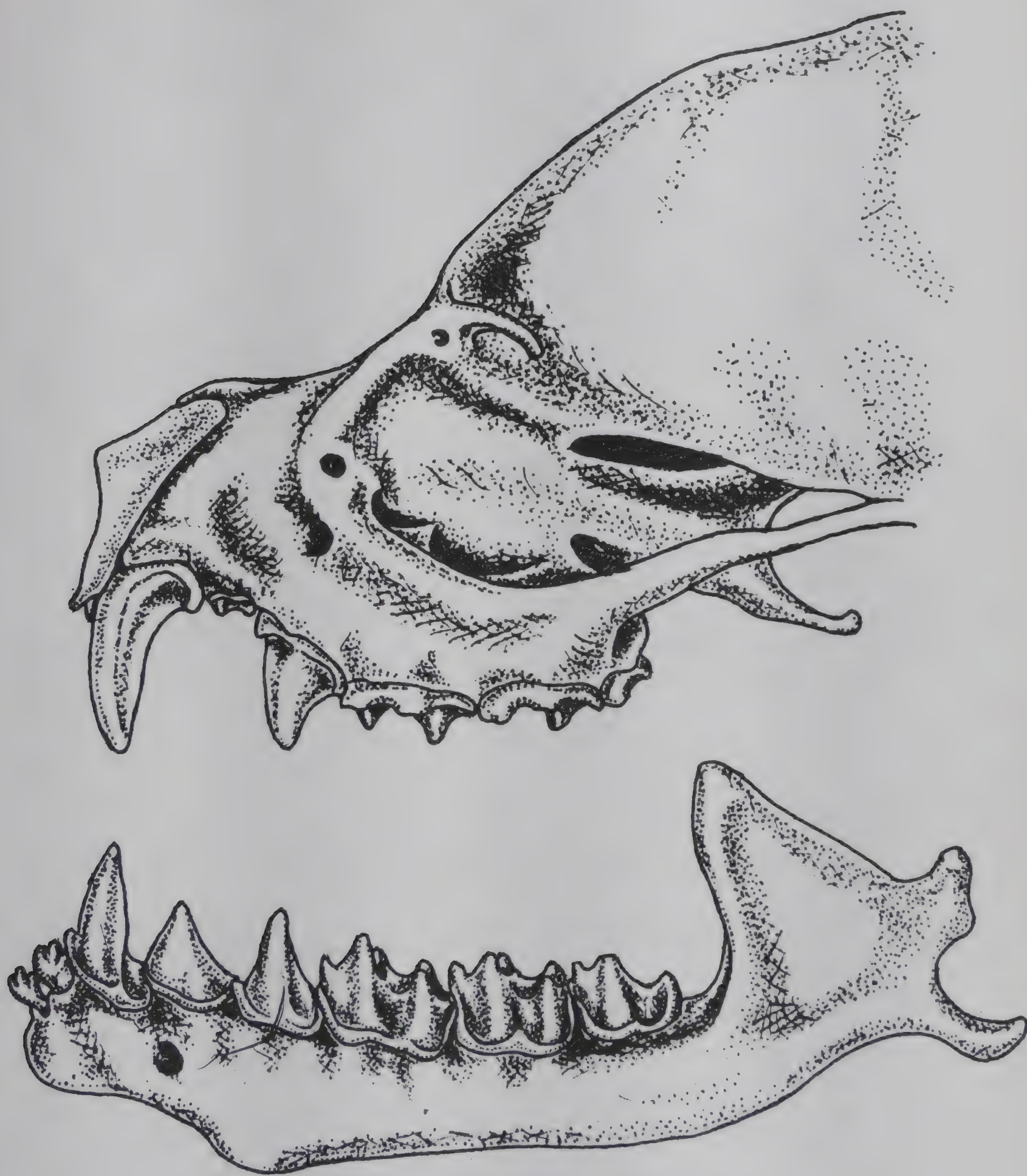


Fig. 5. Skull and dentition of *Taphozous perforatus*. (Scale = 3 mm)





Fig. 6: *Taphozous longimanus* ranges from Sri Lanka and India to Malaysia, Sumatra, Borneo and Java.

In INDIA localities include Nasirabad [1]; Kota [2], (Sinha, 1980) in Rajasthan; Sunwar [nl]; Bulsar [3]; Deogad [4]; Mandra [5]; Mandvi [6], (BMNH coll.); Lunwa [nl]; Palanpur [7], (Ryley, 1914); Ahmedabad [8]; Mehmabad [9]; Anand [10], (Brosset, 1962a); Baroda [11]; Broach [12], (Sinha, 1981a) in Gujarat; Chanda [13]; Bandra [14], (BMNH coll.); Malvan [15]; Panchgani [nl]; Bombay [16], (BNHS coll.); Khed [17], (Wroughton, 1916a); Nagpur [18]; Amaravati [19], (Gopalakrishna, 1954); Arnala [nl]; Elephanta [20]; Khandala [21]; Ratnagiri [22], (Brosset, 1962a) in Maharashtra; Dharwar [23], (BMNH coll.); Sirsi [24]; Sagar [25]; Vijayanagar [26], (Wroughton, 1913); Kolar [27], (Ryley, 1913a) in Karnataka; Travancore [28], (type loc. of *brevicaudus*); Madras [29], (Dobson, 1878); Tirthamalai [30], (BMNH coll.; registered as *T. melanopogon*) in Tamil Nadu; Balapalli Range [31]; Palkonda Hills [32], (BMNH coll.; registered as *T. melanopogon*); locality not located, (Bharatha Lakshmi *et al.*, 1987) in Andhra Pradesh; Sohagpur [33]; Gwalior [34], (BNHS coll.); Hoshangabad [35], (Wroughton, 1913); Jabalpur [36], (Khajuria, 1979) in Madhya Pradesh; Varanasi [37], (Krishna & Dominic, 1985) in Uttar Pradesh; Nimiaghat [38], (Wroughton, 1915); Inanpur [nl]; Chapra [39], (Sinha, 1980); districts of Begusarai [40]; Bhojpur [41]; Giridih [42]; Hazaribag [43]; Patna [44]; Purnea [45]; Saharsa [46]; Saran [47]; Singhbhum [48]; Vaishali [49] and West Champaran [50], (Sinha, 1986) in Bihar; Calcutta [51], (type loc. of *longimanus*); Darjeeling [52], (type loc. of *fulvidus*), Salbani [53]; Midnapore [54], (BMNH coll.); Krishnanagar [55], (Lal & Biswas, 1984) in West Bengal; Agartala [56], (Agrawal & Bhattacharyya, 1977) in Tripura. Extralimital localities are based on BMNH coll. and Phillips (1924) for SRI LANKA and Wroughton (1915a; 1916a); Sinha (1980) and BMNH coll. for northern BURMA.



	Mean	Range	s	n
HB:	78.8	73-86	3.5	29
T:	24.4	20-30	2.5	28
HF:	11.5	8-14	2.0	26
FA:	59.1	56-62	1.5	28
E:	17.2	16-18	0.8	29
GTL:	21.4	20.9-22.0	0.3	25
CBL:	20.0	19.2-21.6	0.6	26
ZB:	12.5	12.0-12.9	0.2	23
BB:	9.9	9.5-10.1	0.1	24
IC:	6.2	5.8-6.5	0.2	27
C-M <sup>3</sup> :	8.9	8.7-9.2	0.2	28
C-M <sub>3</sub> :	9.7	9.4-10.1	0.2	26
M:	15.8	15.4-16.4	0.3	26

*T. melanopogon* or *T. perforatus*. It feeds on dictyoptera (cockroaches) and coleoptera (beetles) (Sinha 1986).

**Biology:** In Uttar Pradesh, there would appear to a clearly defined breeding season with the first pregnancy commencing in mid-January and terminating in late April/May and the second pregnancy terminating in August (Krishna and Dominic 1982). However, in Madhya Pradesh, pregnant and lactating females were collected throughout the year, with some females both lactating and pregnant (Gopalakrishna 1954). Infants are naked and with eyes closed at birth, they weigh 3 grams and have a wingspan of 150 mm, 12% and 32% respectively of adult dimensions; at four weeks they are weaned and attain full adult size in two months (Krishna and Dominic 1983). During the breeding season, males have a well developed pectoral gland which oozes a yellowish creamy secretion with a peculiar bitter smell (Sinha 1986).

**Discussion:** Brosset (1962a) observed this species at Elephanta in March and June when the

#### MATERIAL SEEN AND/OR COLLECTED IN MARCH 1992

Locality (Date)	Size of Colony	No. of specimens taken	Nature of biotope
Elephanta (9 March)	20-25 individuals in three small colonies	1	Roof of principal cave and adjacent room

It may roost in areas exposed to daylight merely shifting its position away from direct sunlight (Sinha 1981a). Colony size ranges from 1 to 100 (Brosset 1962a, Sinha 1986). It appears that individuals of both sexes live together from October to June but the sexes segregate in the non-breeding season, July to September, when the females roost in large unisexual colonies and the males live in small unisexual groups (Krishna and Dominic 1985). It seems unable to compete with other members of the genus and is not usually found in the same diurnal roosts as

colony size was 7 and 5 individuals respectively. It appears therefore that this particular colony has not been adversely affected by the increase of tourism to the caves over the last 30 years. Brosset also recorded a colony of four individuals in November from the Dada Hari Well, Ahmedabad. It was not seen at this locality in March 1992; possibly it was present but remained unobserved or it may have been displaced by the large number of *Taphozous perforatus*.

**Status:** Although this species has a



widespread distribution, population size is relatively low at each locality. Evidence from Elephanta suggests that it is not unduly disturbed by the presence of man and studies such as those of Sinha (1986) suggest that it was relatively abundant in the early 1980s.

### ***Taphozous melanopogon* Temminck, 1841**

#### **- Black-bearded Bat**

*Taphozous melanopogon* Temminck, 1841: Monographies de Mammalogie, 2: 287. Bantam, Western Java.

**External characters:** This species is comparable in size to *T. longimanus* but with an average longer forearm, which usually exceeds 62 mm in length. There is no gular sac in either sex and the chin and throat are always hairy. Males grow, at the age of about six months, a most characteristic beard, which is variable in colour but usually has a jet black central part. During the period of rut small glands under the chin of the male produce a thick secretion which runs over the beard (Brosset 1962a). Pelage colour ranges from russet brown to almost black; the belly is usually a lighter hue than the dorsal aspect. The hair bases are pale and may give the pelage a mottled appearance, especially in females. In contrast to *T. longimanus*, the wings are attached to the tibiae, not the ankle and the fur extends to only one third the length of the humerus and femur on the upper body. The tail is thickened towards the tip and somewhat laterally compressed. The radio-metacarpal pouch of each wing is large.

**Cranial and dental characters:** The skull can be distinguished from that of *T. perforatus* by its average larger size and by the shape of the mesopterygoid space which is V-shaped whilst that of *T. perforatus* is characteristically U-shaped. The basisphenoid pits are also considerably larger. The cranial morphology is closely similar to that of *T. longimanus* and the

skulls of the two species cannot be distinguished with certainty. The maxillary and mandibular tooth rows average longest for the three small species of *Taphozous* found in the region, but are otherwise unremarkable.

**Measurements:** based on specimens of both sexes from throughout the Indian subcontinent.

	Mean	Range	s	n
HB:	78.7	67-87	4.1	39
T:	24.5	20-32	2.6	40
HF:	11.1	8-14	1.4	32
FA:	64.7	58-68	1.9	39
E:	20.0	17-22	1.5	40
GTL:	21.9	21.2-22.5	0.3	31
CBL:	20.2	19.5-21.5	0.4	31
ZB:	12.6	12.0-13.1	0.3	31
BB:	10.0	9.6-10.5	0.2	37
IC:	6.0	5.7-6.4	0.2	37
C-M <sup>3</sup> :	9.0	8.6-9.2	0.1	31
C-M <sub>3</sub> :	9.9	9.3-10.2	0.2	34
M:	16.1	15.7-16.5	0.2	34

**Ecology:** *Taphozous melanopogon* favours hilly and forested areas, with fresh water such as a river or pond in the vicinity (Brosset 1962a). It has been collected from altitudes ranging from sea level in the Andaman Islands (Hill 1967) to 800 metres in Maharashtra (Brosset 1962a). It is highly gregarious and lives in roosts which are usually located in ruins, temples and caves. Colony size varies from a few individuals to 15000 at Mandu (Sapkal and Khamre 1984). Males and females are segregated; either living





Fig. 7: *Taphozous melanopogon* is a widespread species ranging from India to southern China, Java, Borneo and Philippines.

In INDIA localities include Udaipur [1], (Sinha, 1981a) in Rajasthan; Bansda [2], (Sinha, 1981a); Gurudeshwar [3]; Mandla [4], (Khajuria & Ghosal, 1981) in Gujarat; Chikalda [5]; Ajanta [6]; Ellora [7]; Pittalkora [8]; Kanheri [9]; Alibag [10], (Brosset, 1962a); Nagpur [11], (Naidu & Thakare, 1980); Narnala [12]; Raysen [nl], (Sapkal & Khamre, 1984); Daultabad [13], (BNHS coll.); Helwak [14]; Rajapur [15], (BMNH coll.) in Maharashtra; Pattadkal [16]; Badami [17]; Vijayanagar [18]; Gersoppa [19], (Brosset, 1962a) in Karnataka; Keela Kuyil [20], (Usman, 1988); Nagarcoil [21], (Sinha, 1986) in Tamil Nadu; Secunderabad [22], (BMNH coll.); Balapalli Range [23], (Sinha, 1986) in Andhra Pradesh; Bhubaneswar [24], (Khaparde, 1976) in Orissa; Mundra [25]; Narsingarh [26], (Wroughton, 1913); Orcha [27]; Mandu [28]; Asirgarh [29], (Brosset, 1962a); Jabalpur district [30], (Khajuria, 1979); Burhanpur [31], (Badwaik, 1988); Jashpur [32], (Sinha, 1986) in Madhya Pradesh; Patna [33], (Sinha, 1981b) in Bihar; Mandapahar [34], (Hill, 1967) in Andaman Islands. Extralimital localities are based on Phillips (1924); Phillips (in litt.) for SRI LANKA and Wroughton (1915a) for northern BURMA.



in separate colonies or spatially separated within the same colony (Brosset 1962d).

not require any special conservation measures at present.

MATERIAL SEEN AND/OR COLLECTED IN MARCH 1992

Locality (Date)	Size of Colony	No. of specimens taken	Nature of biotope
Daultabad (4 March)	125 individuals in 3 colonies	3	Chambers within the fort
Ellora (4 March)	120 + individuals in 3 colonies	7	In caves 10, 12 & 32
Mandu (11 March)	Many hundreds in several colonies	2	Vast colony in Champba Baoli; others throughout the ruins

**Biology:** There is a sharply defined breeding season, with copulation and fertilisation during the last week of January and parturition between the last week of May and the first week of June in Madhya Pradesh (Sapkal and Khamre 1984); Orissa (Khaparde 1976) and Bihar (Sinha 1986). In coastal Maharashtra, parturition takes place between 20 April and 15 May (Brosset 1962a). The gestation period is 120-125 days and the young weigh 7-8 grams at birth (Sapkal and Khamre 1984). They are carried by their mother for 30 days and are weaned at about two months; juvenile mortality is high, especially when the young first leave their mothers, and some 20% die between the ages of 30 and 40 days (Brosset 1962a). Adult size is attained at four months (Khajuria 1979) and sexual maturity after one year (Sapkal and Khamre 1984). There is usually a single infant, although occasionally twins have also been recorded (Khajuria 1979).

**Discussion:** Brosset (1962a) observed many thousands of specimens in nine localities. Two of these, Ellora and Mandu, were revisited. Although the colonies at Ellora are apparently smaller, it is still present in reasonable numbers; it is flourishing at Mandu.

**Status:** This species is abundant and does

***Taphozous perforatus* E. Geoffroy, 1818**  
- Egyptian Tomb bat

*Taphozous perforatus* E. Geoffroy, 1818: Description de L'Egypt, 2: 126. Egypt.

**External characters:** This is the smallest species of *Taphozous* in India. The gular sac is large in some males but may be difficult to locate in others; it is absent in females. In contrast to *T. longimanus*, the chin is hairy, in both sexes. Both the pelage and membranes are pale. The upper body is light grey-brown with the hair bases whitish; the ventral surface is pale, mouse-grey. The brown hairs on the throat are buffy brown in some specimens. The radio-metacarpal pouches are well developed and the wings are attached to the tibiae, not the ankles as in *T. longimanus*.

**Cranial and dental characters:** The skull is small. The anterior border of the mesopterygoid space is distinctly U-shaped and clearly differs from the V-shaped mesopterygoid spaces of *T. longimanus* and *T. melanopogon*. The basisphenoid pits are the least developed of the three small local species of *Taphozous*. The dentition is relatively light.

**Measurements:** Based on specimens of both sexes from throughout the Indian





Fig. 8: *Taphozous perforatus* ranges from Senegal to Somalia and south to Zimbabwe in Africa; in Asia it is found in Arabia, southern Iran, Pakistan and India.

In INDIA localities include districts of Jodhpur [1]; Dungarpur [2]; Barmer [3], (Sinha, 1980); Jaisalmer [4]; Jhalawar [5], (Advani, 1982a) in Rajasthan; Bhuj [6]; Rajkot [7], (BMNH coll.); Ahmedabad [8]; Bochasan [9]; Chaklasi [10]; Mehmabad [11], (Brosset, 1962a); Rajpipla [12], (Sinha, 1981a) in Gujarat; Jabalpur [13], (Khajuria, 1965) in Madhya Pradesh. The extralimital record for PAKISTAN is based on Siddiqi (1961).



	Mean	Range	s	n
HB:	74.5	71-80	2.1	22
T:	24.0	20-27	1.9	22
HF:	10.1	8-13	1.2	22
FA:	61.3	59-64	1.3	20
E:	18.0	14-20	1.4	22
GTL:	20.5	19.9-21.5	0.4	20
CBL:	19.0	18.4-19.7	0.3	20
ZB:	11.7	11.5-12.0	0.1	21
BB:	9.4	9.2-9.7	0.1	21
IC:	5.8	5.5-6.2	0.2	21
C-M <sup>3</sup> :	8.6	8.2-8.9	0.2	21
C-M <sub>3</sub> :	9.3	9.0-9.6	0.2	21
M:	15.0	14.6-15.6	0.2	21

closely allied species with similar ecological requirements and are not found living together. Natural predators include *Megaderma lyra* (Prakash 1961). It feeds on moths and beetles (Sinha and Advani 1976).

**Biology:** Females give birth to a single infant in May. On 15 June in Ahmedabad, hundreds of females were seen carrying young about 35 days old (Brosset 1962a).

**Discussion:** Brosset (1962a) noted this species from 3 localities, all in Gujarat. Colony sized ranged from a few individuals in the Dada Hari Well, Ahmedabad in November, December and June to 2000- 3000 in a huge roost in a mosque in Ahmedabad in November. In March 1992, in contrast to the findings of Brosset (1962a), there appeared to be no *T. perforatus* residing in the mosques of Ahmedabad but an apparently flourishing colony was observed in the disused Dada Hari Well. This latter colony was not adversely affected by the limited number of tourists visiting this historical site.

**Status:** This species is only known from a

#### MATERIAL SEEN AND/OR COLLECTED IN MARCH 1992

Locality (Date)	Size of colony	No. of specimens taken	Nature of biotope
Ahmedabad (15 March)	150 individuals	4	In Dada Hari Well, in centre of city

subcontinent.

**Ecology:** This species is mostly confined to the more arid areas of north-west India where its roosts are principally located in man-made constructions such as mosques, wells, and village houses (Brosset 1962a). It has also been collected from ruined buildings (Sinha 1981a); artificial tunnels (Bhati 1988) and caves (Prakash 1961). Colony size varies from a few individuals to 2000-3000 in Ahmedabad in November. According to Brosset (1962a), *Taphozous perforatus* and *T. melanopogon* are

few localities in India and as such must be considered vulnerable to local extinction. Evidence from the March 1992 survey suggests that it is surviving well in those roosts that have remained relatively undisturbed.

**Taphozous kachhensis** Dobson, 1872 -  
Naked-rumped Tomb bat

*Taphozous kachhensis* Dobson, 1872:  
Journal Asiat. Soc. Bengal, 41(2): 221. Cutch,  
India.

**External characters:** This is a medium sized





5. *Taphozous longimanus*; 6. *Taphozous melanopogon*; 7. *Taphozous perforatus*; 8. *Taphozous kachhensis*; 9. *Megaderma lyra*.







species of *Taphozous*, characterised by its naked rump, which may contain copious fat reserves. Males have a large gular sac and a deep circular gland in the upper part of the chest; the gular sac is less visible in females and the gland is absent. The chin and throat are essentially naked in both sexes and the head is flattened. The pelage is dark brown above, with pale grey hair bases; it is a slightly lighter hue below. It does not extend on to the wing membranes on the dorsal surface. The upper humerus and forearm, both aspects of the interfemoral membrane, the posterior back, lower abdomen and legs are naked. The wings, which are long and narrow, are attached to the tibiae; the radio-metacarpal pouch of each is very small. The feet have a few characteristically long, pale hairs arising from the backs of the toes. This species has a particularly strong and unpleasant odour.

**Cranial and dental characters:** The skull exceeds that of *T. melanopogon* and the other small *Taphozous* in size, with the zygomata broader and the lambda better developed, usually forming the most backwardly projecting part of the skull. Superficially, it resembles that of *T. saccolaimus* (also found in India) from which it can be distinguished by the structure of the tympanic bullae. In *T. kachhensis*, the antero-internal border of each bulla is incomplete, with the main body of the cochlea readily visible. In *T. saccolaimus*, the tympanic bullae are completely ossified internally and in consequence the main body of cochlea is obscured. The skull is relatively broader than that of *T. theobaldi* (a rare Indian species) and the basisphenoid pits smaller. The dentition is robust in comparison to *T. melanopogon*. In contrast to *T. saccolaimus*, the anterior upper premolar is small, with a surface area of little more than 10-15% that of the second premolar. In *T. saccolaimus*, the anterior upper premolar is

relatively large, with a surface area of 30-50% of the second premolar.

**Measurements:** Based on specimens of both sexes from throughout the Indian

	Mean	Range	s	n
HB:	96.3	90-105	4.2	25
T:	32.6	22-46	5.4	40
HF:	14.6	11-18	1.7	34
FA:	74.3	71-80	2.6	24
E:	22.0	18-25	1.7	40
GTL:	25.8	22.5-27.9	1.6	37
CBL:	23.4	21.6-25.6	1.0	37
ZB:	15.9	14.4-17.8	0.8	37
BB:	11.5	10.6-12.7	0.5	35
IC:	8.1	7.0-8.6	0.7	5
C-M <sup>3</sup> :	10.9	10.3-11.8	0.4	38
C-M <sub>3</sub> :	12.2	11.4-13.3	0.6	38
M:	20.1	18.2-21.5	0.8	38

subcontinent.

**Ecology:** This is a common species in the Indian subcontinent found throughout the more arid regions where rainfall is less than 1275 mm (50 inches) per annum. It is mainly absent from humid areas such as Konkan, the Ghats and Kanara (Brosset 1962a). Roosting sites include man-made caves, temples, tombs, barns, houses, crevices in rocks (Brosset 1962a); underground tunnels (Advani 1980) and swifts' nests (Prakash 1961). Colony size is generally restricted to a few individuals although several hundred were recorded from the cave complex of Ellora (Brosset 1962a). Activity is reduced during





Fig. 9: *Taphozous kachhensis* is restricted to India, Pakistan and Burma.

In INDIA, localities include New Delhi [1], (Brosset, 1962a) in Delhi; the districts of Jodhpur [2]; Kota [3]; Jhalawar [4]; Bundi [5]; Tonk [6], (Sinha, 1980); Ajmer [7]; Banswara [8]; Dungarpur [9]; Sawai Madhopur [10], (Advani, 1980); Sirohi [11]; Pali [12], (Advani, 1982b) in Rajasthan; Keshod [13]; Junagadh [14]; Vankaneer [15], (Ryley, 1913b); Palanpur [16]; Deesa [17], (Ryley, 1914); Rajkot [18]; Bhuj [19]; Ahmedabad [20]; Anand [21]; Vadtal [22]; Bocharan [23], (Brosset, 1962a); Baroda [24]; Broach [25], (Sinha, 1981a) in Gujarat; Ellora [26]; Aurangabad [27]; Ajanta [28], (Brosset, 1962a) in Maharashtra; Vijayanagar [29], (Wroughton, 1913); Sivasamudram [30], (Ryley, 1913a); Badami [31]; Pattadakal [32]; Sirsi [33], (Brosset, 1962a) in Karnataka; Madurai [34], (Marimuthu & Chandrashekar, 1983) in Tamil Nadu; Gwalior [35]; Sanchi [36]; Khajurao [37], (Brosset, 1962a); Jabalpur district [38], (Khajuria, 1979) in Madhya Pradesh; Chunar [39], (BMNH coll.); Fatehpur Sikri [40]; Agra [41], (Brosset, 1962a) in Uttar Pradesh; Gayā [42], (Wroughton, 1915b); Bodh Gaya [44]; Sasaram [45], (Sinha, 1986) in Bihar; Calcutta [46], (Khajuria, 1953); Sivok [47], (Wroughton, 1916b) in West Bengal. Extralimital records are based on Sinha (1980); Wroughton (1916c); Siddiqi (1961) and BMNH coll. for PAKISTAN and Wroughton (1915a) for northern BURMA.



November and December in Gujarat, when individuals no doubt rely on their large fat reserves (Brosset 1962a); in Rajasthan, it is known to migrate (Advani 1980). The diet is comprised of invertebrates such as beetles, moths, crickets, termites and cockroaches; it varies on a seasonal basis and is dependent on availability (Advani 1980):

**Biology:** Copulation and fertilisation takes place during the last week of March and the first week of April (Sapkal and Deshmukh 1985). There is usually a single embryo in the right cornu of the uterus (Sinha 1986). Pregnancy

had observed several colonies, with total numbers between 100 and 200 individuals. There would appear to have been a considerable decline in the population size in many of its former roosts. Probably, the pungent odour of this bat has led to its persecution in many of its traditional roosting sites. This is especially the case in those most frequented by tourists, such as the caves of Ellora and Ajanta.

**Status:** This is a widespread species in India. Formerly very common, it is possible that selective persecution by man may have lead to a significant reduction in population size.

#### MATERIAL SEEN AND/OR COLLECTED IN MARCH 1992

Locality (Date)	Size of colony	No. of specimens taken	Nature of biotope
Aurangabad (3 March)	40 individuals in one colony	3	Buddhist caves - eastern group
Ahmedabad (15 March)	30 individuals in one colony	2	In rooms of mosque adjacent to lake at Sarkhez Roza

lasts about 98 days and parturition occurs in mid July; lactation continues until September (Sapkal and Deshmukh 1985). The infant reaches full adult size in approximately six months (Brosset 1962a); females are sexually mature at nine months and males at 20 months. There is a period of sexual quiescence from the middle of September to March.

**Discussion:** Brosset (1962a) found this species to be abundant. Four of his fourteen localities were revisited in March 1992. It was no longer present at Ellora, although Brosset had noted 800-1000 individuals from numerous colonies in the cave complexes. It was also absent from Ajanta where previously Brosset had observed several colonies. It was found in just one mosque in Ahmedabad and in one cave at Aurangabad. In both these localities, Brosset

#### Family MEGADERMATIDAE

**Megaderma lyra** E. Geoffroy, 1810 - Greater False Vampire

*Megaderma lyra* E. Geoffroy, 1810: Annals Mus. Hist. nat. Paris, 15: 190. Madras, India.

**External characters:** This robust species is significantly larger than the closely allied *Megaderma spasma*, the forearm of which averages 56.9 mm (53-62 mm) in length. The pelage is characteristically grey and the ears are large and oval in shape. They have a distinctive fringe of white hairs on their inner edges and are attached to one another over the forehead. Each ear has a large bifid tragus the posterior process of which is tall and acutely pointed, measuring some 15.5 mm in height. The face is well haired on the forehead and upper cheeks;



however the snout is essentially naked, flesh coloured but with some well defined papillae. There is an erect straight-sided noseleaf, measuring 10 mm in height; it has a longitudinal ridge and a simple rounded horizontal base; in *M. spasma*, the noseleaf is short, 6.5 mm, convex sided and with a distinctly heart-shaped base. The pelage of *M. lyra* is fine and soft throughout. It is a light mouse grey faintly washed with brown above. It is paler on the throat and belly below. The interfemoral membrane is capacious but there is no tail. The wings are broad and the total wing span measures between 380- 440 mm.

**Cranial and dental measurements:** The skull is significantly larger than that of *M. spasma*, the greatest length of which averages 25.6 mm (23.5-26.7 mm). The rostrum is peculiarly modified; the premaxillae are completely absent and the nasals are greatly reduced, so that the massive canines project forwards and form the most anterior part of the skull. In consequence, the upper incisors are lacking. The upper toothrow (C-M<sup>3</sup>) length clearly exceeds that of *M. spasma* which averages 9.8 mm (9.1-10.5 mm). The first upper premolar is minute, concealed between the canine and the second large premolar.

**Dental formula:** i 0/2 c 1/1 pm 2/2 m 3/3 = 28.

**Measurements:** Based on specimens of both sexes from throughout the Indian subcontinent.

**Ecology:** *Megaderma lyra* is a widely distributed bat which has become adapted to man-made biotopes including old buildings, wells, underground tunnels, cow sheds and grain godowns. It also lives in caves. Colony size ranges from a single individual to several hundred; an exceptional breeding colony of 1500-2000 specimens was recorded from Aurangabad by Brosset (1962a). According to

	Mean	Range	s	n
HB:	83.4	75-95	5.7	73
HF:	16.7	14-20	1.4	67
FA:	66.8	61-72	2.1	81
E:	37.9	31-40	1.7	65
GTL:	28.8	27.1-30.2	0.6	61
CBL:	25.4	24.5-26.5	0.5	56
ZB:	16.4	15.4-17.1	0.3	41
BB:	12.2	11.5-12.9	0.2	60
PC:	4.7	4.2-5.2	0.1	63
C-M <sup>3</sup>	11.2	10.8-11.9	0.2	63
C-M <sub>3</sub>	12.2	11.5-12.7	0.3	65
M:	19.8	18.8-21.2	0.5	65

Chandrashekar and Marimuthu (1987), it is a shy species which is easily disturbed by human interference. Generally, it will not leave its diurnal roost until at least one hour after sunset (Brosset 1962a). It locates its live prey by passive listening but uses echolocation to detect dead prey (Beuter *et al.* 1978). The diet is comprised of vertebrates such as frogs, mice, birds, lizards and smaller bats and invertebrates such as termites, wasps, beetles and ants. The proportion of vertebrates to invertebrates changes on a seasonal basis in response to availability (Advani 1981).

**Biology:** Throughout India, the two sexes become synchronously sexually active once a year. The adults copulate in November and females give birth to a single infant in April. Individuals from southern India give birth a few days before those from the north. The mother carries the young for 20-25 days and suckling





Fig. 10: *Megaderma lyra* ranges from Afghanistan to southern China, south to Pakistan, India, Sri Lanka and Malaysia.

In INDIA locality records include Rambon [97], (Chakraborty, 1983) in Jammu & Kashmir; Kangra [1], (Sinha, 1980) in Himachal Pradesh; districts of Ajmer [2], (Advani, 1981); Banswara [3]; Dungarpur [4]; Boondi [nl]; Kota [5]; Jhalawar [6]; Tonk [7]; Sawai Madhopur [8]; Jodhpur [9]; Jhunjhunu [10] and Sirohi [11], (Advani, 1982b) in Rajasthan; Anand [12], (Brosset, 1962b); Garudeshwar [13], (Khajuria & Ghosal, 1981); Surat [14], (Sinha, 1981a); Palanpur [15], (Sinha, 1980); Deesa [16]; Mandvi [17]; Kim [18]; Danta [19], (BMNH coll.) in Gujarat; Ellora [20]; Ajanta [21]; Aurangabad [22]; Borivli [23]; Kanheri [24]; Powai Lake [nl], (Brosset, 1962b); Nasik [25]; Nagpur [26]; Ratnagiri [27], (Sinha, 1980); Bhandara [28], (Gopalakrishna & Badwaik, 1989); Khed [29]; Vijayadurg [30]; Chanda [31]; Chichipalli [nl], (BMNH coll.); Poona [69], (McCann, 1934); in Maharashtra; Honkan [32]; Hangal [33]; Devikop [34], (Wroughton, 1912b); Jog [35]; Honawar [36]; Kardibetta Forest [37]; Vijayanagar [38], (Wroughton, 1913); Seringapatam [39], (Ryley, 1913a); Belgaum [40]; Pattadakal [41], (Brosset, 1962b); Gersoppa [42]; Sagar [43]; Bellary [44], (Sinha, 1980); Kasakola [45]; Srirangapattana [46]; Puttur [47], (Naidu & Gururaj, 1985); Kolar [48]; Sirsi [49], (BMNH coll.) in Karnataka; Trivandrum [50], (Sinha, 1980) in Kerala; Salem [51]; Coimbatore [52], (Sinha, 1980); Tirunelveli [53]; Madurai [54], (Chandrashekar & Marimuthu, 1987); Keela Kuyil Kudi [55]; Pannian Malai [nl] and Seelayampatti [nl] in Madurai District, (Usman, 1988); Madras [56]; Jirthamalai [nl], (BMNH coll.) in Tamil Nadu; Cuddapah [57]; Diguva Metta [nl], (Sinha, 1980); Cumbum [58]; Balapalli [59], (BMNH coll.) in Andhra Pradesh; Chilka Lake [60], (Sinha, 1980) in Orissa; Asirgarh [61], (Wroughton, 1912a); Narsingarh [62]; Mundra [63], (Wroughton, 1913); Jabalpur district [64], (Khajuria, 1979); Sohagpur [65]; Sagar [66]; Gwalior [67]; Hoshangabad [68], (Sinha, 1980) in Madhya Pradesh; Nishangara [nl]; Agra [70]; Gazipur [nl]; Lucknow [71]; Kumaun [72], (Sinha, 1980); Khamaria [73], (HSM coll.); Naini Tal [74]; Ranibagh [75], (BMNH coll.) in Uttar Pradesh; Chaibassa [76], (Sinha, 1980); districts of Aurangabad [77]; Bhagalpur [78]; Dhanbad [79]; Giridih [80]; Gopalganj [81]; Madhubani [82]; Purnea [83]; Saharsa [84] and Vaishali [85], (Sinha, 1986); Nimiaghat [86], (Wroughton, 1915b) in Bihar; Salbani [87], (Wroughton, 1915b); Midnapore [88]; Ranigunj [89]; Calcutta [90], (Sinha, 1980); Siliguri [91]; Hasimara [92]; Jalpaiguri [93], (BMNH coll.) in West Bengal; Sylhet [nl], (Sinha, 1980); Angarakhta [94]; Polahari [95], (BMNH coll.); Mornai [96], (Kurup 1968) in Assam. Extralimital localities are based on Siddiqi (1961), Roberts (1977) and BMNH coll. for PAKISTAN; BMNH coll. for NEPAL; Phillips (1924); Sinha (1980) and BMNH coll. for SRI LANKA; Wroughton (1916a); Sinha (1980) and BMNH coll. for northern BURMA.



## MATERIAL OF SEEN AND/OR COLLECTED IN MARCH 1992

Locality (Date)	Size of colony	No. of specimen taken	Nature of biotope
Belgaum (25 March)	One individual	1	Deserted but structurally sound mosque within Belgaum Fort

continues for a further 15-20 days. The testes of males undergo regression within a short period after copulation. The sex ratio at birth is about even but the proportion of females within the population appears to increase with age as a result of differential rates of mortality (Gopalakrishna and Badwaik 1989).

**Discussion:** Brosset (1962b) located this species at 13 sites at eleven different localities. In the present study, seven of the sites were revisited but only one specimen was observed. This individual was roosting alone in a deserted mosque (Safa Masjid) within an army camp in Belgaum fort. No specimens were seen at Aurangabad, either at the Bibi-ka-Maqbara mausoleum where Brosset had previously observed 1500-2000 specimens in March nor at the near-by Buddhist cave. Brosset recorded a

colony of 15- 20 individuals at Cave No. 3 at Ajanta in March but this was no longer present; all the cave entrances have been fitted with wire-mesh grills. The colonies previously recorded from Ellora and Elephanta were also absent. Possibly, this shy species has been disturbed by an increase in human activity at many of its roosting sites.

**Status:** Our provisional findings would suggest that *Megaderma lyra* is much less abundant than during the time of Brosset's (1962b) survey. If our brief review accurately reflects the current status of this bat it would suggest that some urgent remedial action is required to protect this once abundant species. Further confirmation is provided by Gaur (1979) who noted that two large colonies in the Jodhpur region of Rajasthan had also been abandoned.

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(to be continued)

## ERRATUM

Vol. 91, No. 1.

THE BATS OF WESTERN INDIA REVISITED - PART 1

Plate 1 - Facing page 8,

For 4. *Rhinolophus hardwickii*

Read 4. *Rhinopoma hardwickii*



# A SYSTEMATIC REPORT ON THE FRESH WATER PRAWNS OF THE ATYID GENUS *CARIDINA* H. MILNE-EDWARDS 1837, FROM MADRAS (TAMILNADU : INDIA)<sup>1</sup>

JASMINE RICHARD<sup>2</sup> AND M.R. CHANDRAN<sup>3</sup>  
(With six text-figures)

**Key words:** Atyidae, *Caridina* sp.

The atyid prawns belonging to the genus *Caridina* are widely distributed in the freshwater bodies in and around Madras. Eventhough the first report of an atyid prawn from India was from Madras in the year 1893, no attempt was made thereafter to study the Atyidae of Madras.

The present work is the first systematic report of the *Caridina* sp. of Madras, including a new species. A complete account of synonymy, material examined, type material of the new species, ecology, live coloration, fecundity and larval stages based on laboratory culture, is provided. A key for the identification of the species of *Caridina* in and around Madras is also provided.

## INTRODUCTION

The first freshwater prawn to be described from Madras region was an atyid belonging to the genus *Caridina*, a century back by Henderson (1893). This was incidentally the first report of the family Atyidae from India. Since then, except for the brief accounts by Nobili (1903) and Kemp (1915), there have been no other works on this confusing group along the Tamil Nadu coast. Even from the interior Tamil Nadu, whatever little information available on this group is only by the brief accounts of Roux (1931) and Wycliffe (1973). The present work was, therefore, undertaken with a view to systematically study these prawns which are increasingly becoming popular as crustacean bioassay material in experimental biology among the research workers of this area.

During the course of study, following four species could be collected:

1. *Caridina gracilirostris* De Man, 1892.
2. *Caridina gracilipes* De Man, 1892.
3. *Caridina kunnathurensis* sp. nov.
4. *Caridina gurneyi* Jalihal *et al.* 1984.

The studies on morphometrics dealing with various body proportions have been used for easily distinguishing several species of *Caridina* by Bouvier (1925). In the present work, these ratios are given in Table 1 wherein the following abbreviations are used for indicating lengths of corresponding appendages : al - antennular peduncle, ab6 - sixth abdominal segment, c - carapace, ch1 & ch2 - chela of first and second pereopods (i.e. chelipeds), cp1 to cp5 - carpus of first to fifth pereopods, d1 to d5 - dactylus of first to fifth pereopods, f1 & f2 - fingers of first and second chelipeds, p1 & p2 - palm of first and second chelipeds, pr 3 & pr 5 - propodus of third and fifth pereopods. The suffix b indicates breadth of relevant appendage/segment.

The abbreviations ZSI, NMC and RMNH are used for Zoological Survey of India, Calcutta, National Museum of Natural Sciences, Canada and Rijksmuseum Van Natuurlijke Historie, Leiden, The Netherlands, respectively.

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TABLE 1  
VARIOUS BODY PROPORTIONS OF THE FOUR SPECIES OF *CARIDINA* FROM MADRAS

Body proportions	<i>Caridina gracilirostris</i>	<i>Caridina gracilipes</i>	<i>Caridina kunnathurensis</i>	<i>Caridina gurneyi</i>
1. r/c	1.40 to 2.20	0.90 to 1.20	0.80 to 1.00	0.40 to 0.70
2. al/c	0.60 to 0.90	0.75 to 0.90	0.65 to 0.83	0.40 to 0.50
3. ab6/c	0.60 to 0.90	0.75 to 0.90	0.51 to 0.59	0.35 to 0.45
4. pr3/c	0.30 to 0.40	0.35 to 0.36	0.39 to 0.45	0.34 to 0.70
5. pr5/c	0.38 to 0.50	0.45 to 0.52	0.38 to 0.50	0.36 to 0.62
6. cp1/cp1.b	1.48 to 1.80	2.00 to 2.50	2.77 to 3.10	1.66 to 2.00
7. ch1/ch1.b	2.00 to 2.46	2.40 to 2.64	2.35 to 2.72	1.80 to 2.50
8. fl/p1	0.80 to 1.20	1.32 to 1.50	1.10 to 1.60	0.80 to 1.15
9. cp2/cp2.b	3.80 to 5.10	4.57 to 5.10	4.60 to 5.10	5.23 to 6.00
10. ch2/ch2.b	3.12 to 3.20	2.90 to 3.31	2.35 to 2.72	2.75 to 3.40
11. f2/p2	0.90 to 1.30	1.58 to 1.72	1.35 to 1.75	1.10 to 1.70
12. pr3/pr3.b	10.00 to 12.00	6.81 to 10.50	9.60 to 12.11	10.00 to 11.00
13. pr3/d3	4.50 to 5.60	3.41 to 5.10	3.04 to 4.05	4.00 to 5.30
14. d3/d3.b	2.50 to 3.40	3.50 to 4.10	3.00 to 4.50	2.50 to 2.90
15. pr5/pr5.b	12.60 to 14.50	9.45 to 12.22	12.00 to 16.12	10.00 to 14.00
16. pr5/d5	3.80 to 6.00	2.88 to 4.07	3.53 to 4.50	3.00 to 4.50
17. d5/d5.b	3.10 to 4.00	4.28 to 5.15	4.16 to 6.29	3.75 to 4.75

### 1. *Caridina gracilirostris* De Man, 1892 (Figs. 1 - 2)

*Caridina gracilirostris* : De Man, 1892, *Max. Weber Zool. Ergeb.*, 2:392.

*Caridina gracilirostris* : Bouvier, 1913, *Bull. Sci. Ent. France*, 177-182.

*Caridina gracilirostris* : Kemp, 1918, *Mem. Asiat. Soc. Bengal*, 6: 282.

*Caridina gracilirostris* : Bouvier, 1925, *Encycl. Ent.*, 4: 142.

*Caridina gracilirostris* : Natarajan, 1942, *Curr. Sci.*, 11: 245.

*Caridina gracilirostris* : Johnson, 1961, *Bull. Reffles Mus. Singapore* 26: 124.

*Caridina gracilirostris* : Arudpragasam and Costa, 1962, *Crustaceana*, 4: 7.

*Caridina gracilirostris gracilirostris* : Johnson, 1963, *Bull. natn. Mus. St. Singapore*, 32: 20.

*Caridina gracilirostris* : Pillai, 1964, *J. Mar. biol. Ass. India*, 6: 43.



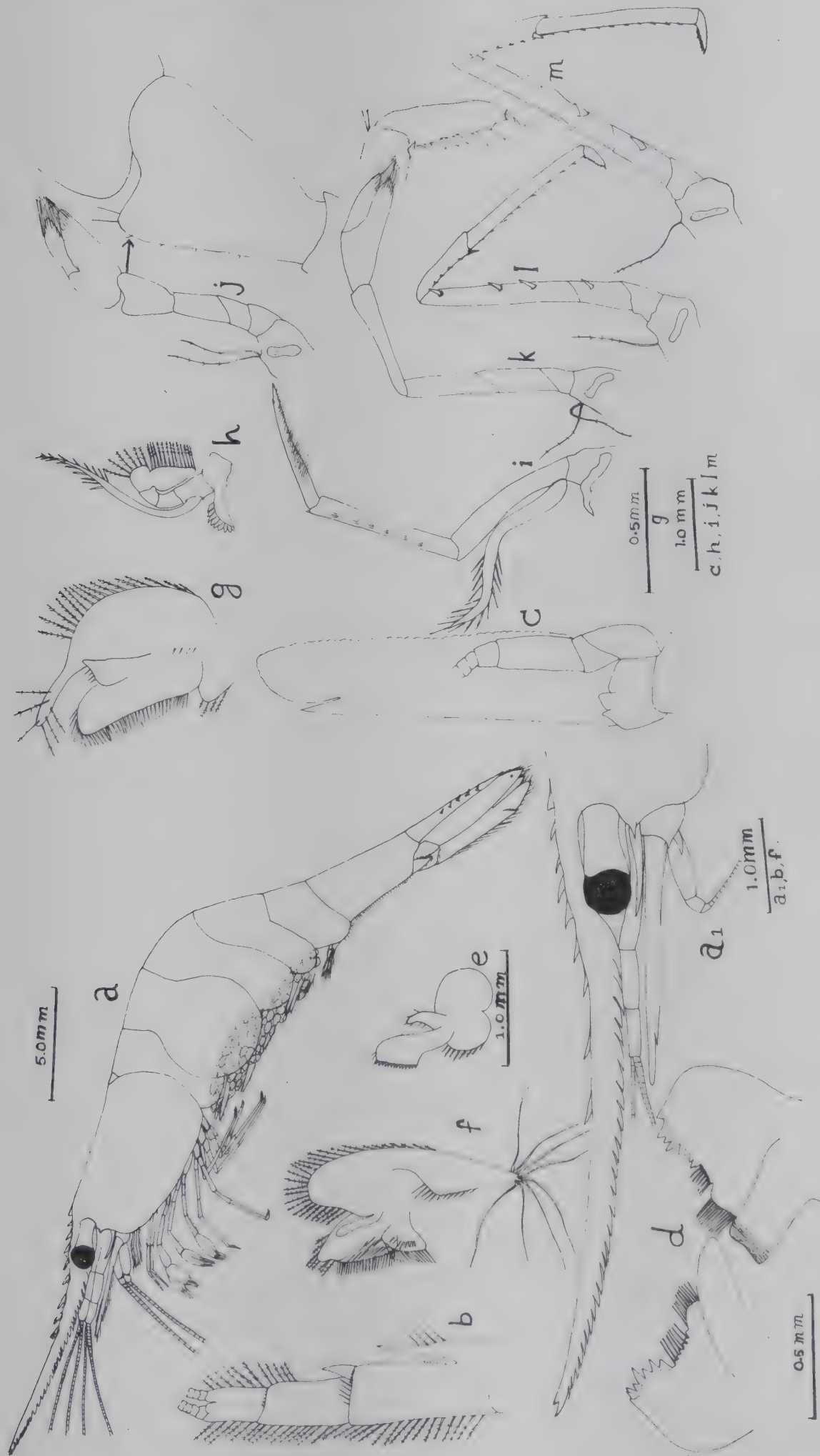


Fig. 1. *Caridina gracilirostris* De Man  
 a. Entire animal (Lateral view); a1. Anterior part (magnified); b. Antennule; c. Antenna; d. Mandibles; e. First maxilla;  
 f. Second maxilla; g. First maxilliped; h. Second maxilliped; i. Third maxilliped; j. First pereopod; k. Second  
 pereopod; l. Third pereopod; m. Fourth pereopod.



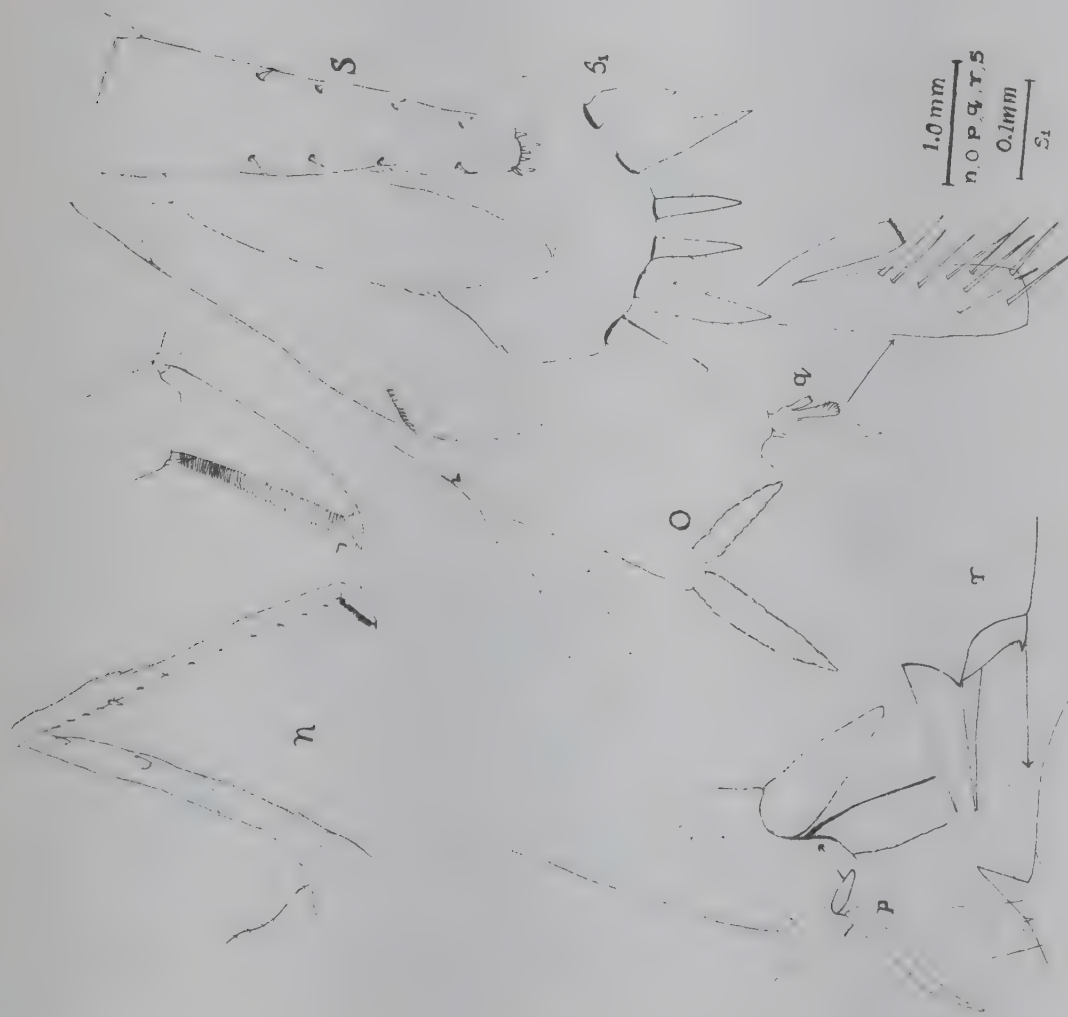


Fig. 1. *Caridina gracilirostris* De Man

n. Fifth pereopod; o. First pleopod of female; p. First pleopod of male; q. Second pleopod of male; r. Preanal carina; s. Telson with uropod;

sl. Posterior part of telson (magnified).

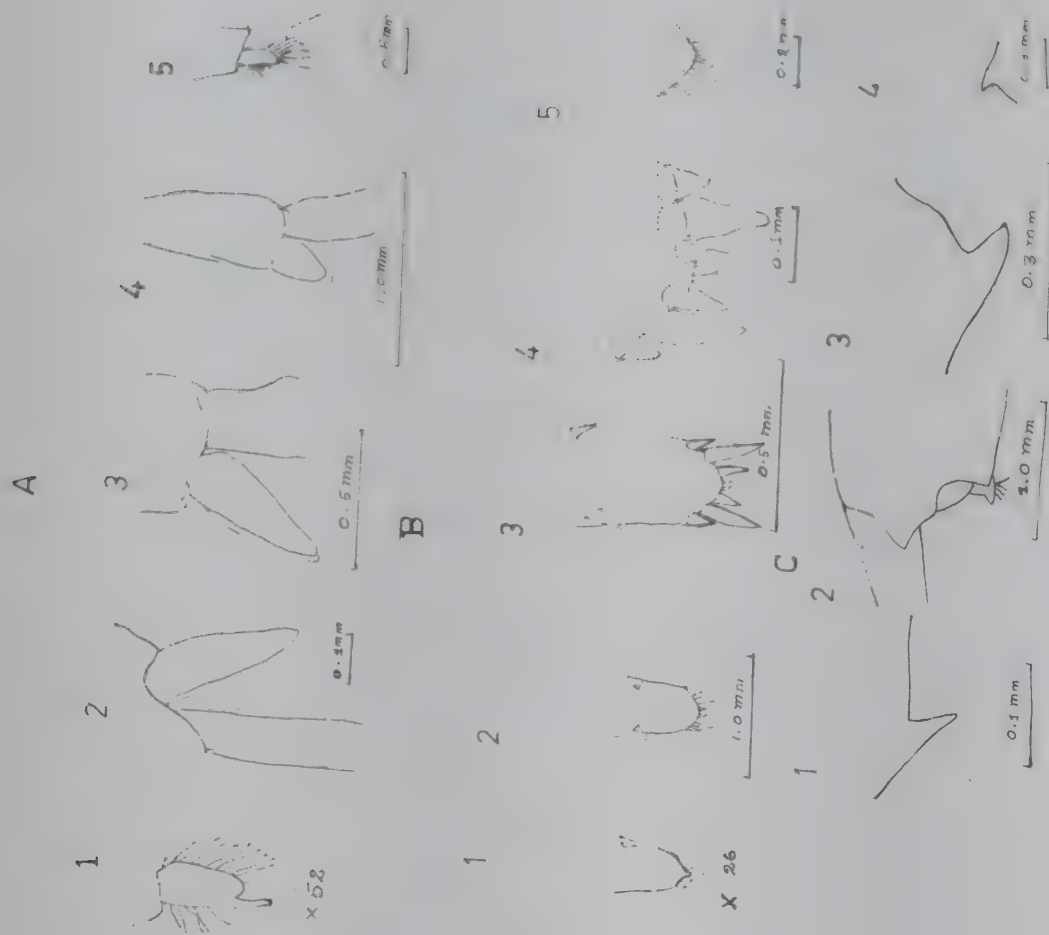


Fig. 2. Comparison of *C. gracilirostris* from various regions

*C. pseudogracilirostris*

A. First pleopod of male of : 1. Madagascar - as per Holthuis (1965); 2. Madras; 3. Andhra Pradesh - as per Ravindranath (1977); 4. ZSI type locality material; 5. Cochin - as per Thomas *et al.* (1973).

B. Posterior portion of the telson of : 1. Madagascar - as per Holthuis (1965); 2. Madras; 3. Andhra Pradesh - as per Ravindranath (1977); 4. ZSI type locality material; 5. Cochin - as per Thomas *et al.* (1973).

C. Preanal carina of : 1. Madras; 2. Andhra Pradesh - as per Ravindranath (1977); 3. ZSI type locality material; 4. Cochin - as per Thomas *et al.* (1973).



*non Caridina gracilirostris* : Holthuis, 1965, *Mem. Mus. nat. Hist. Paris*, 33: 23.

*Caridina gracilirostris gracilirostris* : Tiwari and Pillai, 1971, *Crustaceana* 21: 83.

*Caridina gracilirostris* : Costa, 1972, *Bull. Fish. Res. Stn. Sri Lanka (Ceylon)*, 23: 129.

*Caridina pseudogracilirostris* : Thomas *et al.* 1973, *J. Mar. biol. Ass. India*, 15: 871.

*Caridina gracilirostris gracilirostris* : Ravindranath, 1977, *Ph.d. thesis* (unpublished).

**Material Examined:** 120 specimens collected between January, 1979 and January, 1982 in following freshwater bodies: Chetput pond, Chembambakkam reservoir, Nursery pond of Fisheries Research Station (FRS) at Chembambakkam, Porur and Kunnathur ponds. Sizes: 30 males (25 to 30 mm), 30 non-berried females (29 to 35 mm) and 60 berried females (30 to 42 mm). Also, following material from ZSI was examined : 2 males (29 mm each) and 1 berried female (33 mm), collected from Celebes (type locality) by Prof. Max Weber and determined by the original author De Man (Reg. No. 3935/7), 3 males (23 to 25 mm) and 3 berried females (31 to 34 mm) collected from Garia river near Calcutta by S. Kemp (Regd. NO. 9653/10); 2 males (24 & 26 mm) and 1 berried female (30 mm) collected from Sanguem-Sanvordem by S. Kemp (Reg. No. 9657/10); 3 males (28 to 32 mm) and 3 berried females (30 to 35 mm) collected from Tambrapani River, Tinnelvely by J.R. Hill (Reg. No. 9655/10); 3 males (20 to 25 mm) and 3 berried females (34 to 38 mm) collected from Patani River, Siamese Malay State by N. Annandale (Reg. No. 9658/10).

**Description:** Rostrum long, slender, distally upturned and distinctly overreaching antennal scale. Rostral formula

$$\frac{(1 \text{ or } 2) \ 5 \text{ to } 8 + 1 \text{ or } 2}{26 \text{ to } 29}$$

dorsal teeth occupying proximal 1/3rd region while distal 2/3rd portion unarmed; ventral teeth

closely set and arranged almost up to tip. Carapace without pterygostomial spine but with a well developed antennal spine. Cornea well pigmented.

Antennular carina feebly developed, stylocerite long and slender, reaching 3/4th of the basal segment; antero-lateral tooth long and pointed; aesthetasc bearing segments 20 to 25 in females and 38 to 45 in males. Antennal scale long and about 4 times as long as broad.

Mouthparts normal; mandibles asymmetrical and without palp, third maxilliped with an epipod and extending up to 2nd segment of antennular peduncle; exopod reaching middle of the 2nd segment of endopod.

First chelipeds extending up to basal segment of antennular peduncle; carpus only slightly excavated anteriorly. Second chelipeds slender and extending up to antennular peduncle; carpus slender and without anterior excavation. Third pereopod extending up to 2nd segment of antennular peduncle; dactylus with 8 to 11 (mostly 8 or 9) spines; merus bearing 3 stout spines along its inner border. Fourth pereopod similar to third, while fifth extending up to basal segment of antennular peduncle; dactylus with 33 to 45 (mostly 33 to 38) comb-like spinules; merus with 2 stout spines along inner margin.

Epipod present on first 4 pereopods while all 5 pereopods bear 1 or 2 setobranchs.

Abdomen slender, with a dorsal hump on 3rd segment. Endopod of first pleopod of male 2.90 to 3.30 times as long as broad, 0.18 to 0.27 times exopod and without bearing an appendix interna. Appendix masculina 0.31 to 0.36 times endopod and 1.50 to 2.00 times appendix interna.

Telson with 4 or 5 (mostly 4) pairs of dorsal spines and 3 pairs of posterior processes that are sparsely plumose excepting outermost pair. Uropod diaeresis with 6 to 10 (mostly 6 or 8) spinules.



**Eggs and development:** Eggs slightly yellowish, small measuring  $0.26$  to  $0.37 \times 0.47$  to  $0.58$  mm. Fecundity 150 to 750. Development prolonged with 6 larval stages.

**Coloration:** Specimens collected from localities rich in vegetation tend to be greenish while those from open waters exhibit pale yellow coloration; original coloration is retained when kept in mud pots and cement containers but turns pale yellowish when kept in glass aquaria.

**Remarks:** *Caridina gracilirostris* is one of the most common atyids inhabiting Indo - Malayan archipelago (De Man 1892, Kemp 1918, Natarajan 1942, Johnson 1961 & 1963, Arudpragasam and Costa 1962, Pillai 1964, Holthuis 1965, Tiwari and Pillai 1971, Costa 1972, Ravindranath 1977). Holthuis (1965) categorically stated and illustrated that posterior margin of telson in this species is pointed and the endopod of the first pleopod of male possesses a distinct appendix interna. Since these two characteristic features were absent in their specimens, Thomas *et al.* (1973) erected a new species *C. pseudogracilirostris* for their Cochin specimens which had rounded telson and lacked interna on first male pleopod. In all probability, Thomas *et al.* (1973) were not aware of the syntype telson figure of *C. gracilirostris* as given by Bouvier (1925). The figure clearly shows that telson is very much rounded and not pointed in original *gracilirostris*.

As far as the first appendix interna on first pleopod of male is concerned, Ravindranath (1977) draws a rather unacceptable conclusion that it might be present only for a short time during the breeding season in *gracilirostris*. Such a hypothesis can only be confirmed by studying a large series of material collected throughout the year (Gordon 1933). Hence, in the present study special observations were made in this regard and it was confirmed that the relevant

appendix interna is totally lacking in the Madras specimens irrespective of seasons or size.

Also, the personal examination of specimens of *C. gracilirostris* collected from type locality as well as different parts of India and Malaysia (ZSI, Calcutta) clearly proved that its telson is always rounded and its male does not possess appendix interna on first pleopod at any stage of its life. This observation further proves that the Madagascar specimens of Holthuis (1965) may altogether belong to different species and that *C. pseudogracilirostris* of Thomas *et al.* (1973) is merely a synonym of *C. gracilirostris*.

## 2. *Caridina gracilipes* De Man, 1892 (Fig. 3)

*Caridina wyckii* var. *gracilipes* : De Man, 1892, *Max Weber Zool. Ergeb.*, 2: 387. *Caridina wyckii* : Henderson, 1893, *Trans. Linn. Soc. London*, 5: 434. *Caridina wyckii* : Nobili, 1903, *Boll. Mus. Zool. Anant. Comp. Torino* 18: 6. *Caridina nilotica* var. *bengalensis* : De Man, 1908, *Rec. Indian Mus.*, 2: 265. *Caridina nilotica* var. *gracilipes* : De Man, 1908, *Rec. Indian Mus.*, 2: 270. *Caridina nilotica* var. *bengalensis* : Kemp, 1915, *Mem. Indian Mus.*, 5: 307. *Caridina nilotica gracilipes* : Kemp, 1918, *Rec. Indian Mus.*, 14: 275. *Caridina nilotica* var. *bengalensis* : Bouvier, 1925, *Encycl. Ent. ser. A.*, 4: 154. *Caridina nilotica* (Roux) var. *bengalensis* : Wycliffe, 1973, *J. Madurai Univ.* 1: 161. *Caridina bengalensis* : Ravindranath, 1977, *Ph.D. thesis* (unpublished): 239. *Caridina nilotica* var. *bengalensis* : Anatha Raman *et al.* 1978, *Vignana Bharati*, 4(2): 86.

**Material Examined:** Prawns were collected from January, 1979 to January 1982 in various freshwater bodies in and around Madras such as Chetput pond, Chembarambakkam reservoir, nursery ponds FRS Chembarambakkam, Kunnathur pond, YWCA pond and Adyar river (near Saidapet).

**Size:** 30 males (22 to 30 mm); 35 non-berried females (25 to 32 mm) and 80 berried females (30 to 40 mm). Also, the syntype material of *Caridina nilotica* var. *bengalensis*



from ZSI was examined: 1 berried female (19 mm), 1 non berried female (18 mm) and 3 males (16 to 20 mm) (Reg. No. 5615-7/10 wrongly labelled as 5 males).

**Description:** Rostrum straight, equal to or slightly longer than antennal scale. Rostral formula

$$\frac{(1 \text{ or } 2) \ 10 \text{ to } 24 + 0 \text{ to } 2}{11 \text{ to } 22} \text{ mostly}$$

$$\frac{(2) \ 17 \text{ to } 20 + 1 \text{ or } 2}{14 \text{ to } 17}$$

dorsal margin with a distal gap which may rarely be interrupted by 1 or 2 intermediate teeth. Carapace without pterygostomial spine but with a prominent antennal spine at orbital expansion. Cornea round and well pigmented.

Antennular carina poorly developed; stylocerite reaching 3/4th of basal segment; anterolateral tooth sharply pointed and reaching proximal 1/3rd of 2nd segment. Aesthetascs - bearing segments 24 to 33 in females while 45 to 50 in males. Antennal scale about 3-4 times as long as broad.

Mouthparts as in figure. Third maxilliped with an epipod and extending up to 2nd segment of antennular peduncle.

First chelipeds extending up to base of antennular peduncle; carpus slightly excavated anteriorly. Second chelipeds slender and extending up to 2nd segment of antennular peduncle; carpus comparatively slender and without anterior excavation; Third pereopod extending up to tip of antennular peduncle; dactylus with 7 to 10 (mostly 8 or 9) spines; merus with 2 to 4 big spines and ischium with a single big spine along inner margin. Fourth pereopod almost similar to third. Fifth pereopod extending up to 2nd segment of antennular peduncle; dactylus bearing 50 to 70 spinules on posterior margin giving a comb-like appearance; merus almost double of carpus and

with 2 or 3 stout spines but ischium without any spine.

All five pereopods with 2 setobranchs each while only first four pereopods possess epipods.

Abdomen with a prominent hump on 3rd segment. Endopod of first pleopod of male 0.25 to 0.30 times exopod, 2.0 to 2.5 times as long as broad and with a distinct appendix interna. Appendix masculina 0.3 to 0.4 times as long as endopod and 1.5 to 1.8 times appendix interna.

Preanal carina with a strong spine and with a few setae.

Telson posteriorly either with a triangular median point flanked by 3 pairs of processes or blunt bearing 3 or 4 + 1 + 3 or 4 processes. Uropod diaeresis with 9 to 12 (mostly 10 or 11) spinules.

**Eggs and Development:** Eggs yellowish, small, measuring 0.24 to 0.38 × 0.38 to 0.55 mm. Fecundity : 200 to 850. Development prolonged with 7 larval stages before postlarva.

**Coloration:** Freshly collected specimens are slightly greenish and retain this coloration when kept in mud pots or cement tanks but turn pale yellow when maintained in glass aquaria. Ventral margin of rostrum, front of carapace, junction of abdominal pleura and base of telson with prominent orange-red coloration.

**Remarks:** The present species has the distinction of being the first reported atyid from India. It was recorded from Madras (Henderson 1893) and Pondichery (Nobili 1903) under the name *Caridina wyckii*. Subsequently De Man (1908) synonymised it with *C. nilotica* var. *bengalensis* and listed its differences from the closely allied form *C. nilotica* var. *gracilipes* as under:

Present material encompasses all the ranges mentioned above for the two varieties in



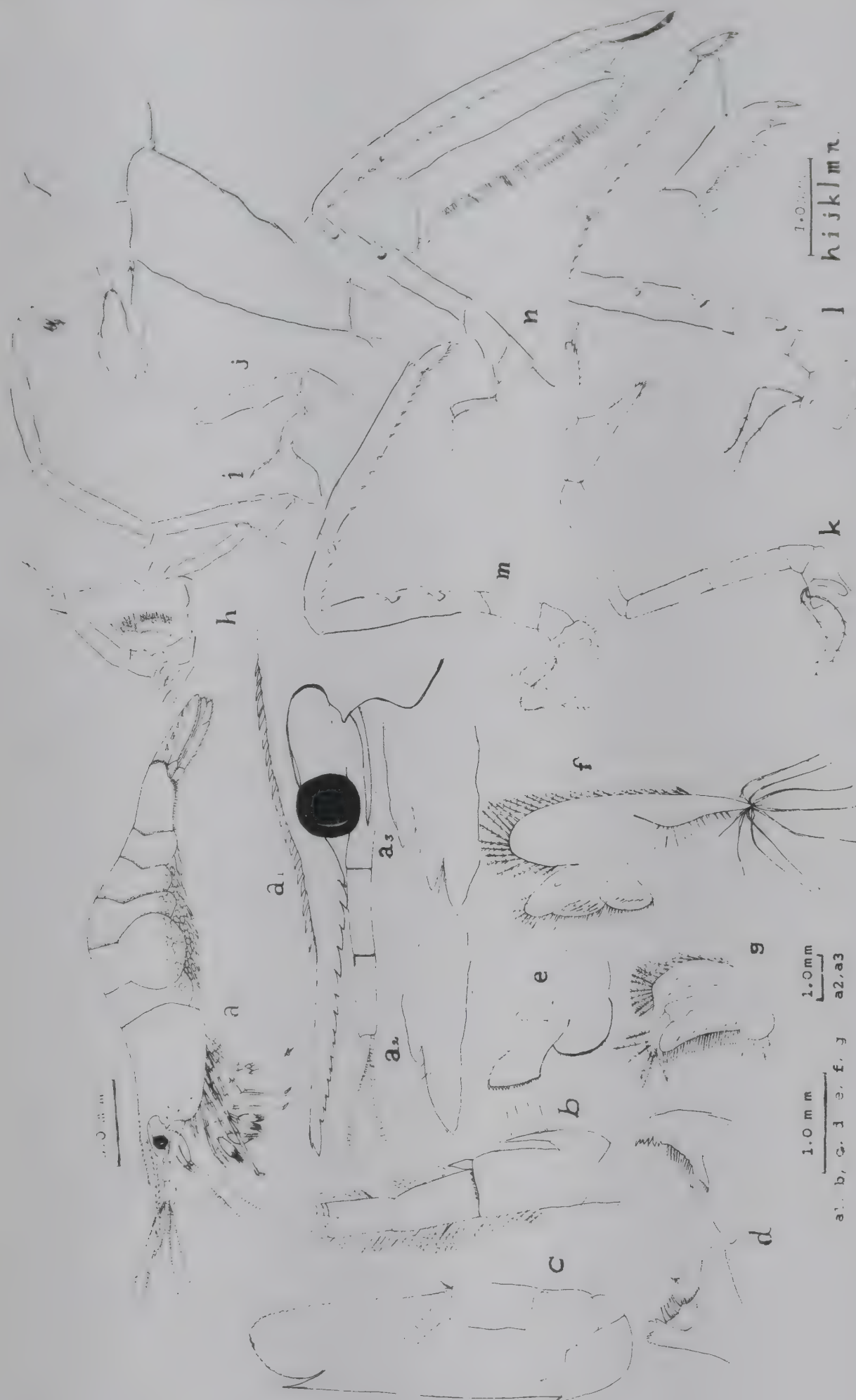


Fig. 3. *Caridina gracilipes* De Man

- a. Entire animal (lateral view); a1. Anterior part of specimen; a2, a3. Tip of the rostrum of two different specimens;  
 b. Antennule; c. Antenna; d. Mandibles; e. First maxilla; f. Second maxilla; g. First maxilliped; h. Second maxilliped;  
 i. Third maxilliped; j. First pereopod; k. Second pereopod; l. Third pereopod; m. Fourth pereopod; n. Fifth  
 pereopod.



Characters	<i>C. nilotica</i> var. <i>bengalensis</i>	<i>C. nilotica</i> var. <i>gracilipes</i>
<b>I. ROSTRUM:</b>		
1. Proximal teeth on upper margin	Mostly 20 to 24	Mostly 12 to 20
2. $\frac{\text{Armed portion}}{\text{Unarmed portion}}$	2.0 to 4.50	0.33 to 1.00
3. Subapical teeth	1 to 4 (mostly 1 or 2)	Mostly 1, rarely 2
<b>II. EGGS:</b>		
4. Length (mm)	0.42 to 0.49	0.33 to 0.40

possessing following features:

1. Rostral formula:  $\frac{12 \text{ to } 26 + 1 \text{ to } 4}{11 \text{ to } 22}$
2.  $\frac{\text{Armed portion of rostrum}}{\text{Unarmed portion of rostrum}}$  : 0.90 to 2.00
3. Egg length (mm): 0.38 to 0.55 mm

It is thus clearly seen that above two varieties merely represent the two extremes of variations exhibited by a single species only. In fact Kemp (1915, 1918), based on his extensive study, stated that separation of the two based only on rostral teeth is untenable and synonymised *bengalensis* with *gracilipes*.

However, Bouvier (1925) once again separated the two on the ground the  $\frac{d5}{pr5}$  is less than 0.25 (0.18 to 0.20) in *bengalensis* but more than 0.25 (0.26 to 0.27) in *gracilipes*. This observation apparently is incorrect since based on measurements given for syntype by De Man (1908), these values can be calculated as 0.30 to 0.35 and 0.26 to 0.27 respectively in the two species.

While treating the two as separate forms, Johnson (1963) synonymised Kemp's (1918) *gracilipes* from Shanghai as well as De Man's (1908) and Kemp's (1915) *bengalensis* from

India, with the Sri Lankan species *C. simoni* but De Man's (1892 & 1908) original *gracilipes* from Celebes with *C. wyckii*.

However, Ravindranath (1977), rightly pointing out that *bengalensis* can be easily separated from *simoni* in possessing at least one subapical dorsal rostral tooth as against none in the latter species, raised *bengalensis* to species level. Apparently he had failed to appreciate: (1) similarities between *bengalensis* and *gracilipes*, (2) that *wyckii* is distinct from *gracilipes* in possessing only 2 or 3 pairs of dorsal spines on telson and longer dactylus of walking legs. Therefore, the name *gracilipes* gains priority over *bengalensis* as pointed out by Kemp (1915, 1918).

Also, it was interesting to find out that in spite of being very similar to the present material, Ravindranath's (1977) Andhra Pradesh specimens are apparently unique in possessing 'blunt' preanal carina. However, personal examination revealed that all the specimens in the syntype series of *Caridina nilotica* var. *bengalensis* possess well developed sharp spine. Thus, Ravindranath's (1977) Andhra Pradesh material differs from Madras material and type material in possessing a blunt preanal carina.

However, it was also observed that all the male specimens in the syntype series lacked appendix interna on first pleopod. This may be



entirely due to their small size (16 to 20 mm only). Nevertheless, it would be worthwhile to study this appendage in the type material of *C. gracilipes* also.

### 3. *Caridina kunnathurensis* sp. nov.

(Figs. 4-5)

**Material Examined:** 100 specimens collected from January 1979 to January 1982 in the following localities - Kunnathur pond, Reservoir and FRS nursery ponds at Chembarambakkam: 20 males (15 to 22 mm), 30 non-berried females (20 to 27 mm) and 50 berried females (20 to 30 mm).

**Holotype:** 1 adult male (19 mm) deposited at NMC (Reg. No. NMC - C 1983 - 447).

**Paratypes:** 3 males, 5 non-berried females, 9 berried females and 6 juveniles deposited at RMNH (Reg. No. Crust. D. 35564).

**Type Locality:** Kunnathur pond, Madras, India.

**Description:** Rostrum equal to or slightly longer than antennal scale. Rostral formula  $\frac{(3 \text{ to } 5) \ 17 \text{ to } 32}{7 \text{ to } 14}$  mostly  $\frac{(4) \ 20 \text{ to } 26}{7 \text{ to } 11}$ ,

dorsal margin of rostrum with a distal gap generally interrupted by 0 to 5 teeth, ventral teeth compactly arranged except distal 1/3rd portion. Carapace without pterygostomial spine but antennal spine distinct and with a small orbital expansion, cornea rounded and well pigmented.

Antennular carina not pronounced; stylocerite slender and reaching 2/3rd of basal segment; antero-lateral tooth reaching basal 1/3rd of second segment; aesthetasc bearing segments 18 to 20 in females and 28 to 33 in males. Antennal scale about 3.5 times as long as broad.

Mouth parts normal, as in figure. Third maxilliped extending up to 2nd segment of antennular peduncle.

First chelipeds extending up to base of antennular peduncle; carpus slightly excavated anteriorly. Second chelipeds extending up to base of antennular peduncle; carpus slender and without anterior excavation. Third pereopod extending up to second segment of antennular peduncle; dactylus with 8 to 10 (mostly 9 or 10) spines; merus about 1.80 times carpus and bearing 4 or 5 stout spines along its inner margin. Fourth pereopod similar to third but comparatively slender. Fifth pereopod extending up to second segment of antennular peduncle; dactylus with 38 to 53 comb-like spinules; merus about 1.5 times carpus and bearing 2 to 4 spines; ischium without any spine.

One or two setobranchs on all five pereopods while each of first to fourth pereopods with an epipod.

Abdomen with a characteristic hump on 3rd segment. Endopod of first pleopod of female 0.65 to 0.70 times exopod and without appendix interna while that of male 0.30 to 0.40 times exopod; 2.40 to 2.60 times as long as broad with a distinct appendix interna. Appendix masculina about 0.35 times endopod and 1.20 to 1.40 times appendix interna.

Preanal carina smoothly curved and without any spine but only with a few setae.

Telson with 5 or 6 pairs of dorsal spines and bearing 4 or 5 (mostly 5) pairs of almost same sized plumose processes posteriorly. Uropod diaeresis with 10 to 13 (mostly 11 to 13) spinules.

**Eggs and Development:** Eggs yellowish, fairly large (0.45 to 0.60 × 0.70 to 1.00 mm) and less in number (40 to 150). Development partially abbreviated with only 3 larval stages before postlarva.

**Coloration:** Body greenish but lower margin of rostrum, anterior and posterior margins of carapace, junction of abdominal



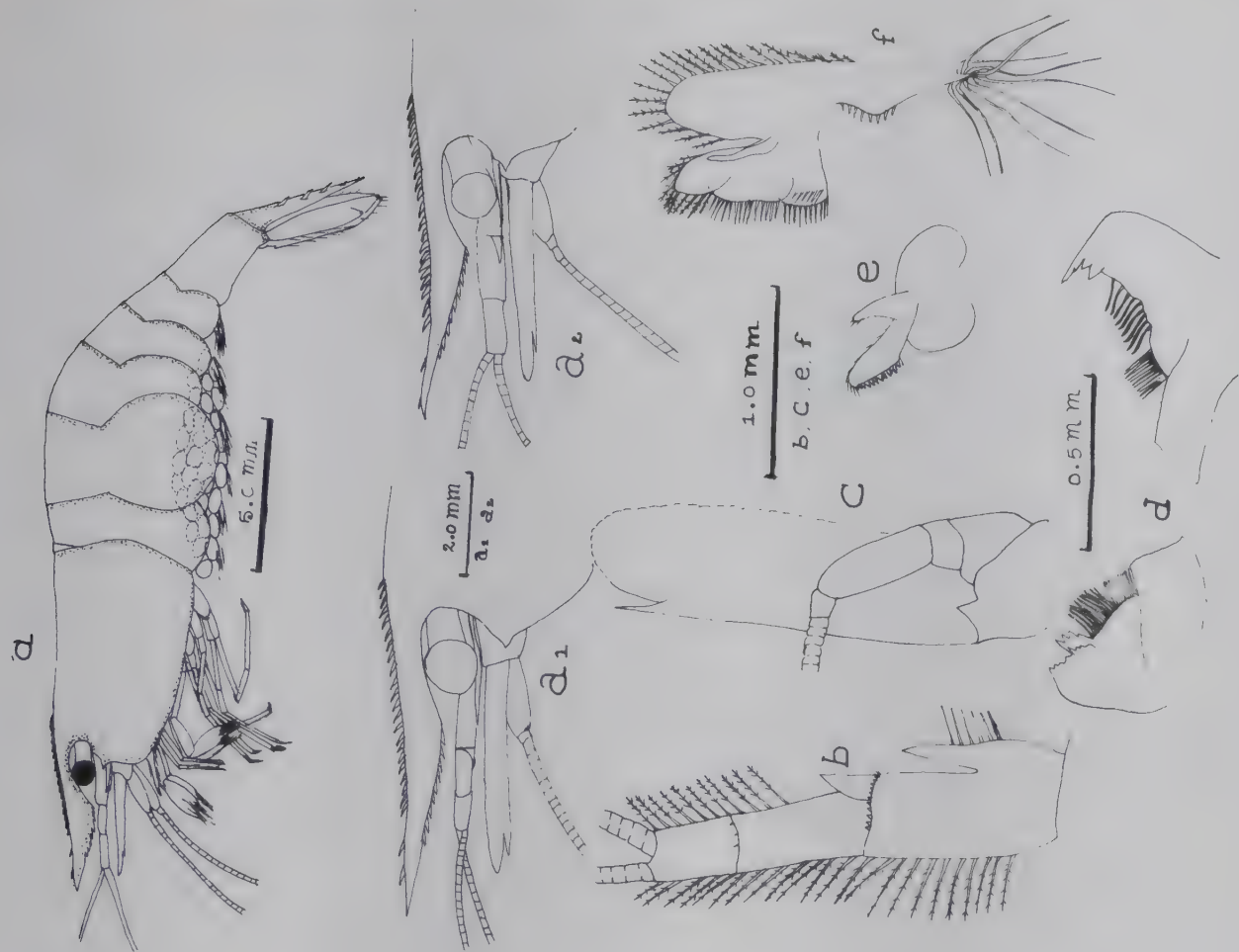


Fig. 4. *Caridina kunnathurensis* sp. nov.  
a. Entire animal (lateral view); a1, a2. Anterior part of two different specimens; b. Antennule; c. Antenna; d. Mandibles; e. First maxilla; f. Second maxilla.



Fig. 3. *Caridina gracilipes* De Man  
o. First pleopod of female; p. First pleopod of male; q. Second pleopod of male; r. Preanal carina; r1. Preanal carina (of *C. bengalensis* Andhra Pradesh); s. Telson with uropods; s1. Posterior part of telson.



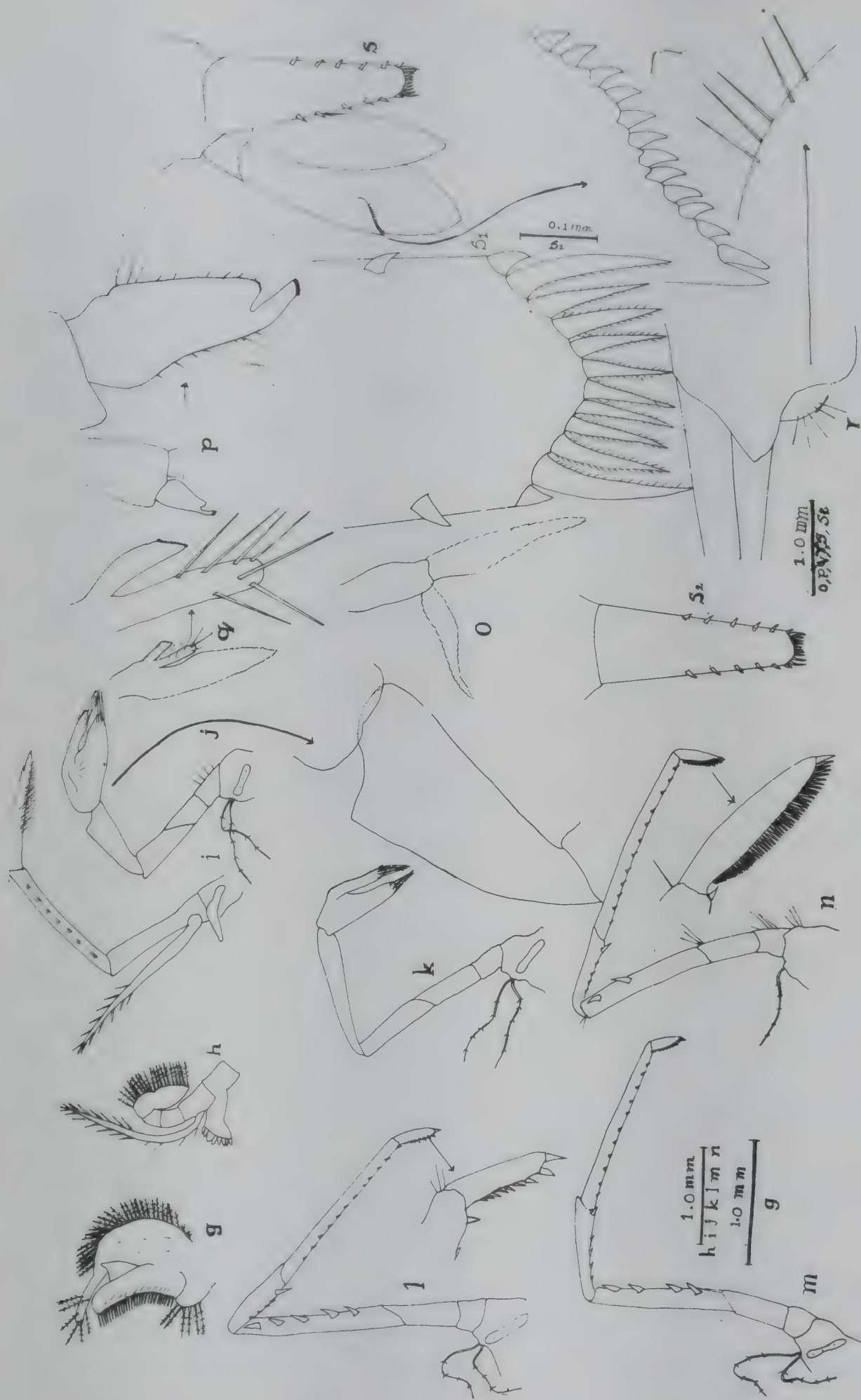


Fig. 4. *Caridina kumathurensis* sp. nov.

g. First maxilliped; h. Second maxilliped; i. Third maxilliped; j. First pereopod; k. Second pereopod; l. Third pereopod; m. Fourth pereopod; n. Fifth pereopod; o. First pleopod of female; p. First pleopod of male; q. Second pleopod of male; r. Preanal carina; s. Telson with uropod; s1. Posterior part of telson; s2. Telson.



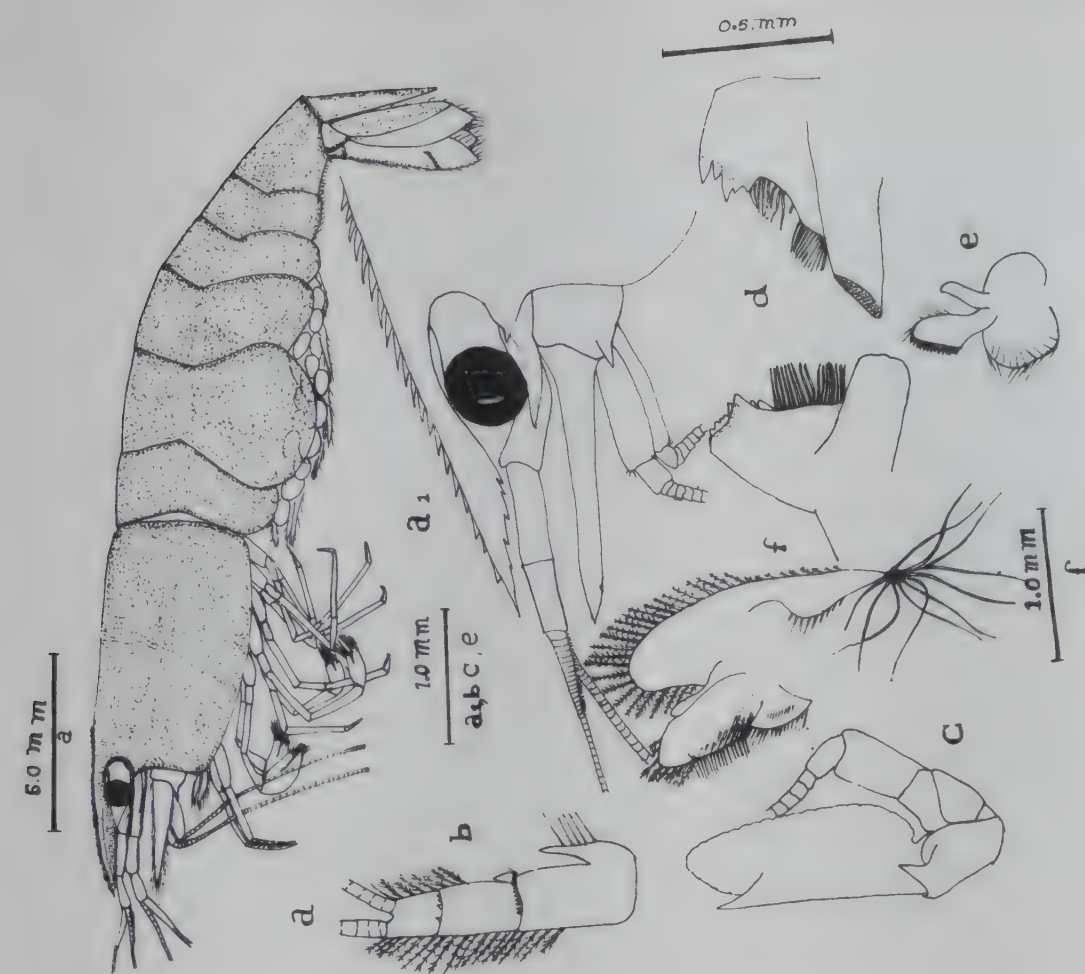


Fig. 6. *Caridina gurneyi* Jalihal *et al.*  
 a. Entire animal (Lateral view); a1. Anterior part of animal;  
 b. Antennule; c. Antenna; d. Mandible; e. First maxilla;  
 f. First maxilla.

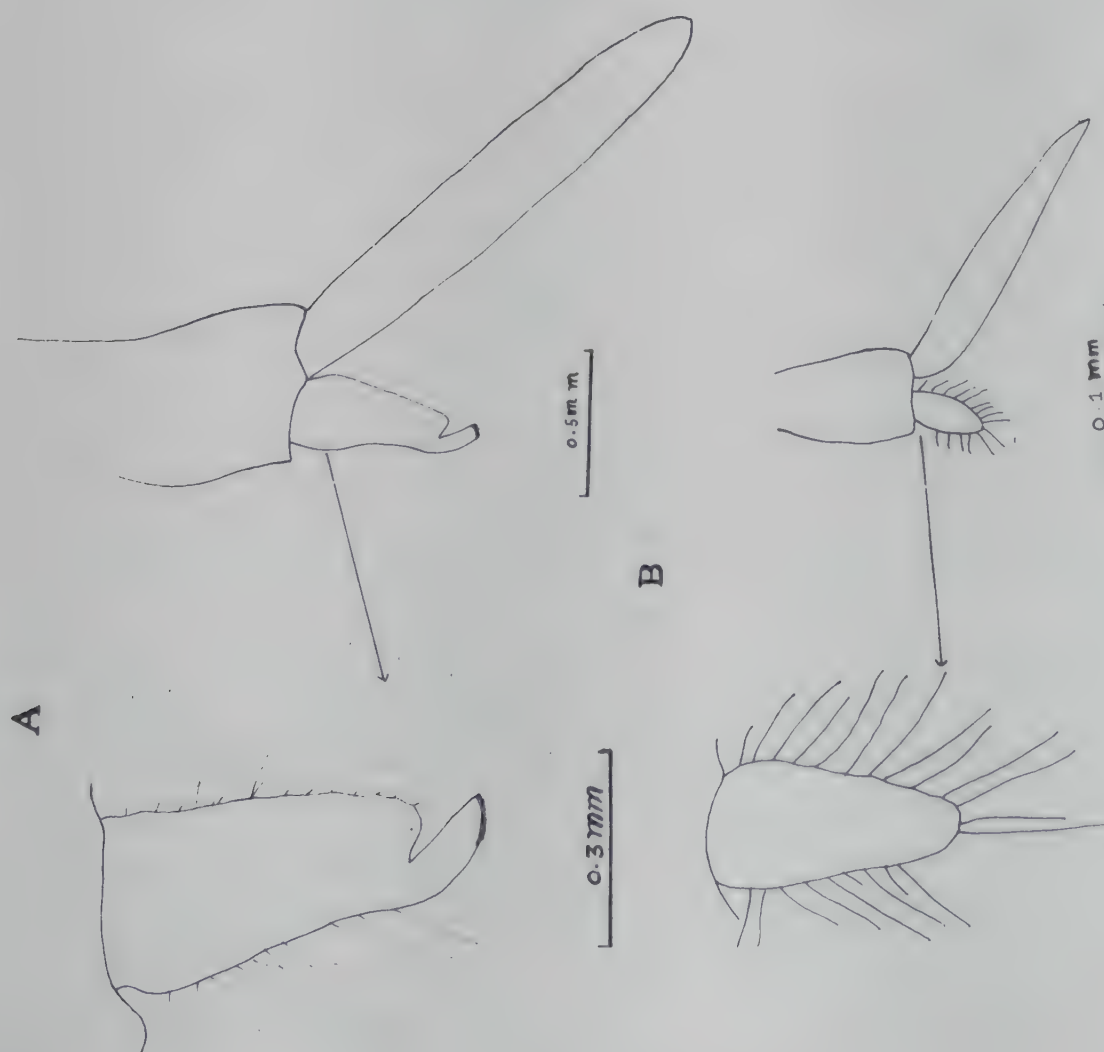


Fig. 5. Comparison of the first pleopod of *C. kunnathurensis*  
 and *C. n. macrophora* male.  
 First pleopod of: A. *C. kunnathurensis*; B. *C. n. macrophora*.



pleura and base of telson with orange-red coloration.

**Remarks:** Among the so far known species of *Caridina*, the new species closely resembles *C. nilotica macrophora* described by Kemp (1918) from Lake Tale Sap, Siam (presently Thailand) in (i) general shape of body, (ii) shape of rostrum and arrangement of teeth and (iii) large size of eggs ( $0.45$  to  $0.60 \times 0.70$  to  $1.00$  mm) in *kunnathurensis* and  $0.52$  to  $0.58 \times 0.90$  to  $0.96$  mm in *macrophora*.

However, examination of syntype material of *macrophora* (ZSI Reg. No. 9665/10 -

Range of dorsal teeth	13 to 16	17 to 20	21 to 32
Percentage frequency in <i>kunnathurensis</i>	0	20	80
Percentage frequency in <i>macrophora</i>	72	28	0

Further, the number of post-orbital teeth is 3 to 5 (mostly 4) in *kunnathurensis* as against only 1 to 3 (mostly 2) of *macrophora*.

Species	No. of examples	Dorsal / Upper Margin				Ventral / Lower Margin			
		Range	Mean	S.E.	S.D.	Range	Mean	S.E.	S.D.
<i>kunnathurensis</i>	100	17-32	22.74	$\pm 0.14$	1.40	7-14	9.65	$\pm 0.17$	1.70
<i>macrophora</i>	50	13-20	15.58	$\pm 0.13$	1.30	6-12	8.60	$\pm 0.10$	1.00

collected in and near the mouth of Patalung river, Tale Sap) revealed the total absence, in that species of appendix interna on first pleopod of males. It also differs from the present new species in the following features:

**Rostral formula:** Number of dorsal teeth in *macrophora* is lesser (13 to 20, mostly 13 to 16, average : 15.58) than in *kunnathurensis* (17 to 32, most 20 to 26, average 22.74). The break-up percentage frequency distribution of dorsal teeth in the two species into 3 groups is given below:

It is clearly seen that less number of teeth (i.e. 13 to 16) are overwhelmingly frequent in *macrophora* while larger number of teeth (i.e. 21 to 32) are predominant in *kunnathurensis*. Although a similar tendency is exhibited by the ventral teeth also, it is not that well marked. The range, mean, standard deviation (S.D.) and standard error (S.E.) of mean of upper and lower teeth in both the species are as under:

**Second chelipeds:** Carpus of second chelipeds is comparatively stouter in *kunnathurensis* (4.60 to 5.10 times as long as broad) than in *macrophora* (5.50 to 7.00 times as long as broad).

**Telson:** Dorsal margin in *kunnathurensis* bears 5 or mostly 6 pairs of spines while in *macrophora* only 3 pairs of spines are present.

**Uropod Diaeresis Spinules:** *C. kunnathurensis* bears 10 to 13 (mostly 11 to 13) spinules while *macrophora* bears only 5 to 7 spinules.

**Etymology:** The new species is named after the village Kunnathur (25 km away from Madras), where it is available in plenty.

#### 4. *Caridina gurneyi* Jalihal *et al.*, 1984 (Fig. 6)

*Caridina gurneyi* Jalihal *et al.*, 1984, *Rec. Zool. Surv. India*. Occ. paper No. 69: 29.



**Material Examined:** 65 specimens collected from January 1979 to January 1982 in the ponds of Kunnathur and My Lady's Garden - 10 males (19 to 23 mm), 25 non-berried females (21 to 24 mm) and 30 berried females (24 to 30 mm).

**Description:** Rostrum gradually sloping anteriorly and falling just short of tip of antennular peduncle. Rostral formula

$\frac{(3 \text{ to } 6) \ 14 \text{ to } 27}{3 \text{ to } 7}$ , post-orbitals mostly 5 or 6;

teeth arranged equidistantly up to tip without any gap. Carapace without pterygostomial spine but antennal spine distinct with a small orbital expansion. Cornea rounded and well pigmented.

Antennular carina prominent; stylocerite reaching 3/4th of basal segment; antero-lateral tooth blunt and reaching barely 1/4th of middle segment. Aesthetasc bearing segments 24 to 30 in females and 31 to 46 in males. Antennal scale about 2.5 times as long as broad.

Mouth parts normal; mandibles asymmetrical and without palp. Third maxilliped extending up to tip of antennular peduncle.

First chelipeds extending up to base of antennular peduncle; carpus with a deep anterior excavation. Second chelipeds slender and extending up to antennular peduncle; carpus slender, without anterior excavation. Third pereopod extending up to tip of antennular peduncle; dactylus with 8 to 10 (mostly 9 to 10) spines; carpus with 1 and merus with 4 stout spines along inner margin. Fourth pereopod almost similar to third. Fifth pereopod extending up to base of antennular peduncle; dactylus with 36 to 48 comb-like spinules; merus with 2 large inner spines while ischium without any spines.

All five pereopods with 3 (occasionally 4) setobranchs each, first four also with an epipod each.

Abdomen rather stout and without a dorsal hump. Endopod of first pleopod of female nearly as long as exopod; that of male about 0.35 times exopod and with a distinct appendix interna. Appendix masculina 0.40 to 0.50 times endopod and 1.60 to 1.80 times as long as appendix interna.

Preanal carina produced into a blunt posterior projection and with a few setae.

Telson 1.10 to 1.20 times as long as sixth abdominal segment and with 4 to 6 (mostly 4 or 5) pairs of dorsal spines; posterior margin almost rounded with 4 or 5 dorsal setae and 4 to 6 (mostly 4 or 5) pairs of plumose processes, outermost pair being totally smooth along outer margin and only sparsely plumose along inner margin; Uropod diaeresis with 15 to 19 (mostly 18 or 19) spinules.

**Eggs and Development:** Eggs dark brownish, considerably large, measuring  $0.51$  to  $0.59 \times 0.81$  to  $1.00$  mm. Fecundity 50 to 105. Development partially abbreviated with 3 larval stages before postlarva.

**Coloration:** Pitch black in colour with a whitish brown mid-dorsal longitudinal band extending from base of rostrum to base of telson. Each abdominal segment with diffused white transverse bands.

**Remarks:** The present material agrees well with *Caridina gurneyi* described from Western Ghats in north Karnataka (Jalihal 1978 & Jalihal *et al.* 1984). However, following differences have been noticed in the adults and larvae:

The above differences are quite sufficient to merit a new nomenclature to the present material. However, taking into consideration our rather inadequate knowledge of this highly variable group, especially of those belonging to



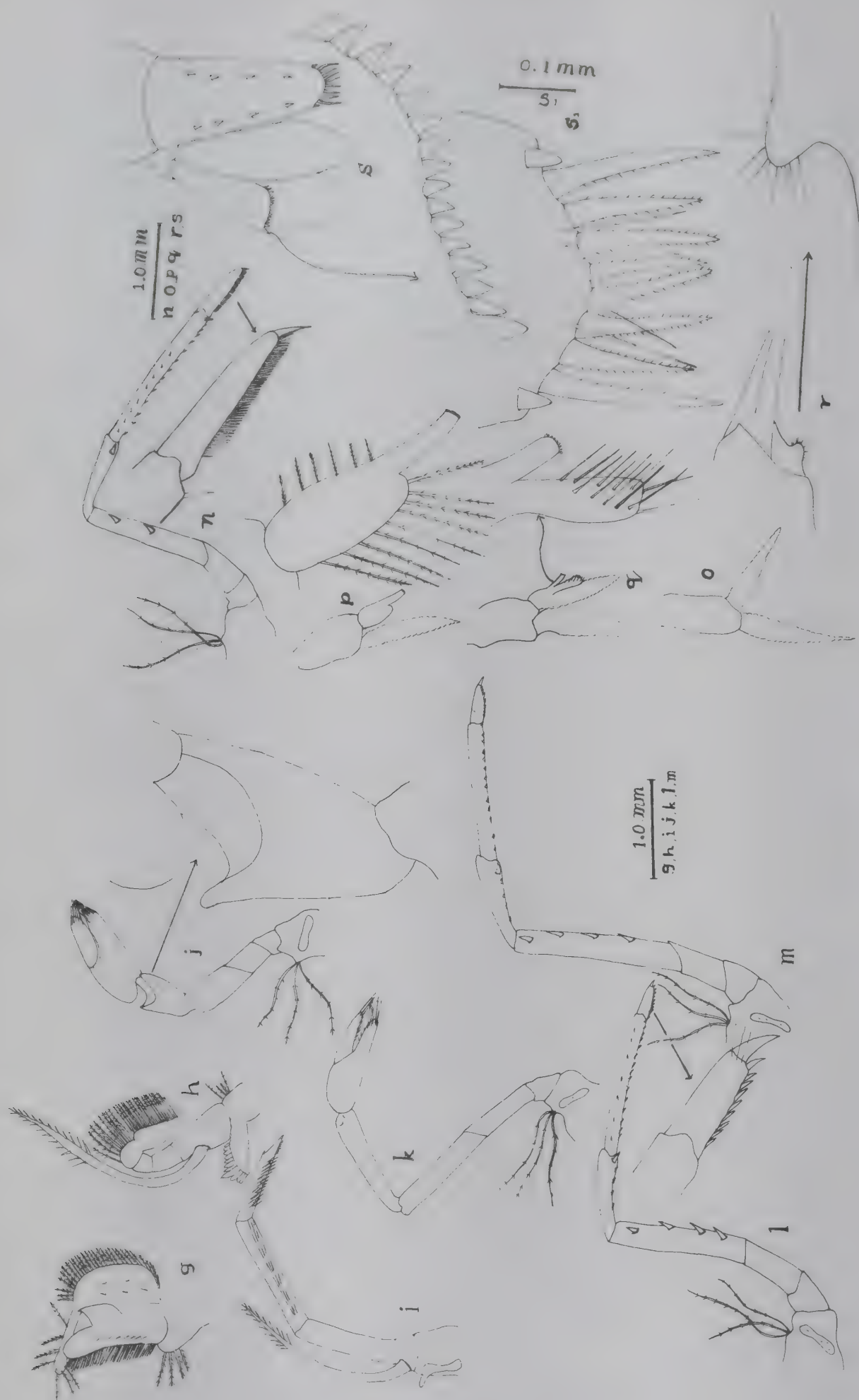


Fig. 6. *Caridina gurneyi* Jalihal *et al.*

f. Second maxilla; g. First maxilliped; h. Second maxilliped; i. Third maxilliped; j. First pereopod; k. Second pereopod; l. Third pereopod; m. Fourth pereopod; n. Fifth pereopod of female; o. First pleopod of female; p. First pleopod of male; q. Second pleopod of male; r. Preanal carina; s. Telson with uropod; sl. Posterior part of telson.



Characters	Western Ghats Specimens (Jalihal 1978 and Jalihal <i>et al.</i> 1984)	Present Material
<b>I. ADULTS:</b>		
1. Extension of rostrum	Longer, being equal to antennular peduncle.	Shorter, failing to reach tip of antennular peduncle.
2. Dactylus of third pereopod	With 5 to 8 (mostly 6 or 7) spines.	With 8 to 10 (mostly 9 or 10) spines.
<b>II. LARVAE:</b>		
<b>A) FIRST ZOAEA:</b>		
3. Extension of rostrum	Longer, extending beyond sessile eyes.	Shorter, failing to extend beyond sessile eyes.
4. No. of aesthetascs	2	3
5. Spine at base of antennal flagellum	Smooth.	Serrated.
6. Endopod of second maxilla	Longer than scaphognathite.	Shorter than scaphognathite.
7. First two pereopods	Exhibits chelate nature.	Do not show chelate nature.
8. Pleopod buds	Biramous.	Uniramous.
<b>B) SECOND ZOAEA:</b>		
9. Antennal scale	With an outer spine.	Outer spine absent.

the '*Caridina weberi sumatrensis*' complex, like the present one, it is decided to designate the material to *C. gurneyi* until more detailed studies are undertaken.

KEY TO SPECIES OF THE GENUS *Caridina* H. MILNE-EDWARDS, 1937, IN AND AROUND MADRAS

1. Abdomen stout and without any dorsal hump. Rostrum shorter than antennal scale; upper margin completely armed without any distal gap. Carpus of first cheliped with a deep anterior excavation. Setobranchs on pereopods always 3 in number. Uropod diaeresis spinules always more than 14. Eggs large being  $0.51$  to  $0.81 \times 0.81$  to  $1.00$  mm and 50 to 105 in number. Larval development partially abbreviated comprising 3 zoeal stages . . . . *C. gurneyi* Jalihal *et al.* 1984
- Abdomen slender and with a dorsal hump. Rostrum equal to or longer than antennal scale; upper margin with a distinct distal gap. Carpus of first cheliped with a very feeble anterior excavation. Setobranchs on pereopods not more than 2 in number. Uropod diaeresis spinules always less than 14 . . . . . 2
2. Rostrum slender and distinctly longer than scale; upper margin with always less than 12 teeth and with an uninterrupted distal gap; lower margin with always more than 20 teeth. Carpus of first cheliped stouter, being always less than twice as long as broad. Posterior margin of telson usually with 6 spine-like (non-plumose) processes. First pleopod of male without appendix interna. (Eggs small, being  $0.26$  to  $0.37 \times 0.47$  to  $0.58$  mm and 150 to 750 in number. Larval development prolonged, comprising 6 zoeal stages) . . . . . *C. gracilirostris* De Man, 1892



- Rostrum stouter and subequal to antennal scale; upper margin always with more than 12 teeth and distal gap may be interrupted by 1 to 5 teeth; lower margin always with less than 20 teeth. Carpus of first cheliped comparatively slender, being always more than twice as long as broad. Posterior margin of telson always with more than 6 setae like (plumose) processes. First pleopod of male with a well developed appendix interna ..... 3
- 3. Distal gap of rostrum rarely interrupted by 1 or 2 teeth; post-orbitals 1 or 2; teeth on lower margin arranged up to tip; Preanal carina with a distinct posteriorly directed spine. (Eggs small  $0.24$  to  $0.38 \times 0.38$  to  $0.55$  mm and more 250 to 850 in number. Larval development prolonged with 7 zoeal stages) ..... *C. gracilipes* De Man, 1892
- Distal gap of rostrum almost always interrupted by 1 to 5 teeth; post-orbitals 3 to 5; distal 1/3rd of lower margin always unarmed. Preanal carina blunt, without any spine. Eggs large  $0.45$  to  $0.60 \times 0.70$  to  $1.00$  mm and less 40 to 150 in number. Larval development partially abbreviated. Consisting of 3 zoeal stages ..... *C. kunnathurensis* sp. nov.

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# POPULATION DYNAMICS OF ASSASSIN BUGS FROM THE COURTALLAM TROPICAL EVERGREEN FOREST IN THE WESTERN GHATS OF TAMIL NADU<sup>1</sup>

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(With three text-figures)

**Key words:** population dynamics, assassin bugs, Courtallam, Western Ghats

Twenty four species of reduviids belonging to 15 genera and 4 subfamilies were collected from the habitats adjacent to the mainfalls and five falls area of Courtallam tropical evergreen forest. At mainfalls *Acanthaspis siva* population was regulated both by biotic (prey) and abiotic (meteorological) factors. However, *Petalochirus brachialis* was regulated neither by biotic nor by abiotic factors. At five falls, the onset of south-west monsoon was found as the indicator for the onset of harpactorine population and their disappearance after December was attributed to their migration outward in search of prey.

## INTRODUCTION

Several groups of predaceous terrestrial Heteroptera as possible biocontrol agents, have been studied in detail. Reduviidae, as predominant group among predatory insects, has received very little attention, as a group of beneficial predators (Ambrose 1988). A knowledge on the distribution, diversity, and population dynamics of these bugs is a prerequisite for any programme on biocontrol. This prompted the authors to investigate the distribution and population dynamics of assassin bugs in Courtallam tropical evergreen forest in the Western ghats of Tamil Nadu.

## MATERIALS AND METHODS

In Courtallam, the population dynamics study was carried out in two areas: (i) mainfalls and (ii) five falls areas. These study areas are unique in their physiognomy as well as in the distribution and the diversity of reduviid fauna. *A. siva* and *P. brachialis* were found in the

mainfalls area. The five falls area has dense growth of teak and scattered taller trees and harbours the harpactorine reduviids, such as, *S. pubinotum*, *E. plagiatus*, *I. armipes* and *C. crocatus*. Six microhabitats 3 each from mainfalls and five falls were randomly chosen. Each microhabitat covers an area with 75-100 trees or shrubs or both. The population of males, females as well as nymphal instars encountered in these microhabitats were carefully counted once in a fortnight.

## RESULTS

**1. DISTRIBUTION OF REDUVIIDS:** Intensive collection in this area yielded 24 species of reduviids belonging to 4 sub-families and 15 genera. Table 1 indicates that the subfamily Harpactorinae predominates with 16 species followed by Reduviinae (4) and Echtrichodiinae (3). The subfamily Salyavatinae is represented by the lone species *Petalochirus brachialis*. Except the sexually dimorphic *Edocla annulata*, all other species are alate. Eight species have tibial pads in their fore and mid legs whereas 16 species are devoid of tibial pads. Seventeen species (mostly harpactorines) glue their eggs to the substratum with spumaline, the gluing

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material whereas 7 species lay their eggs loosely on the substratum. Twelve species have slightly curved rostrum, six species have curved rostrum, 4 species have acutely curved rostrum and 2 species with straight rostrum.

## 2. Population dynamics of reduviids:

2.1. Mainfalls area: Fig.1 shows the fluctuation in the population of *A. siva* from November 1988 to March 1989. Lower temperature and wind velocity and higher

TABLE 1  
ASSASSIN BUGS COLLECTED FROM COURTALLAM TROPICAL EVERGREEN FOREST

No.	Name	Nature of Rostrum	Nature of tibial pad		Nature of Wing	Eggs
			Fore leg	Mid leg		
I. ACANTHASPIDINAE						
1.	<i>Acanthaspis siva</i> Distant	AC	+	+	AL	LS
2.	<i>A. rama</i> Distant	AC	+	+	AL	LS
3.	<i>Edocla annulata</i> Distant	AC	+	+	SD	GL
4.	<i>Velitra sinensis</i> Walker	AC	+	+	AL	LS
II. ECHTRICHODIINAE						
5.	<i>Echtrychotes</i> sp.	C	+	+	AL	LS
6.	<i>Labidocoris elegans</i> Mayr	C	+	+	AL	LS
7.	<i>L. tuberculatus</i> Ambrose & Vennison	C	+	+	AL	LS
III. HARPACTORINAE						
8.	<i>Cydnocoris crocatus</i> Stål	SC	-	-	AL	GL
9.	<i>C. gilvus</i> Burmeister	SC	-	-	AL	GL
10.	<i>Endochus umbrinus</i> Distant	SC	-	-	AL	GL
11.	<i>Euagoras plagiatus</i> Burmeister	C	-	-	AL	GL
12.	<i>Euagoras</i> sp.	C	-	-	AL	GL
13.	<i>Irantha armipes</i> Stål	C	-	-	AL	GL
14.	<i>I. consobrina</i> Distant	S	-	-	AL	GL
15.	<i>Rhinocoris kumarii</i> Ambrose & Livingstone	SC	-	-	AL	GL



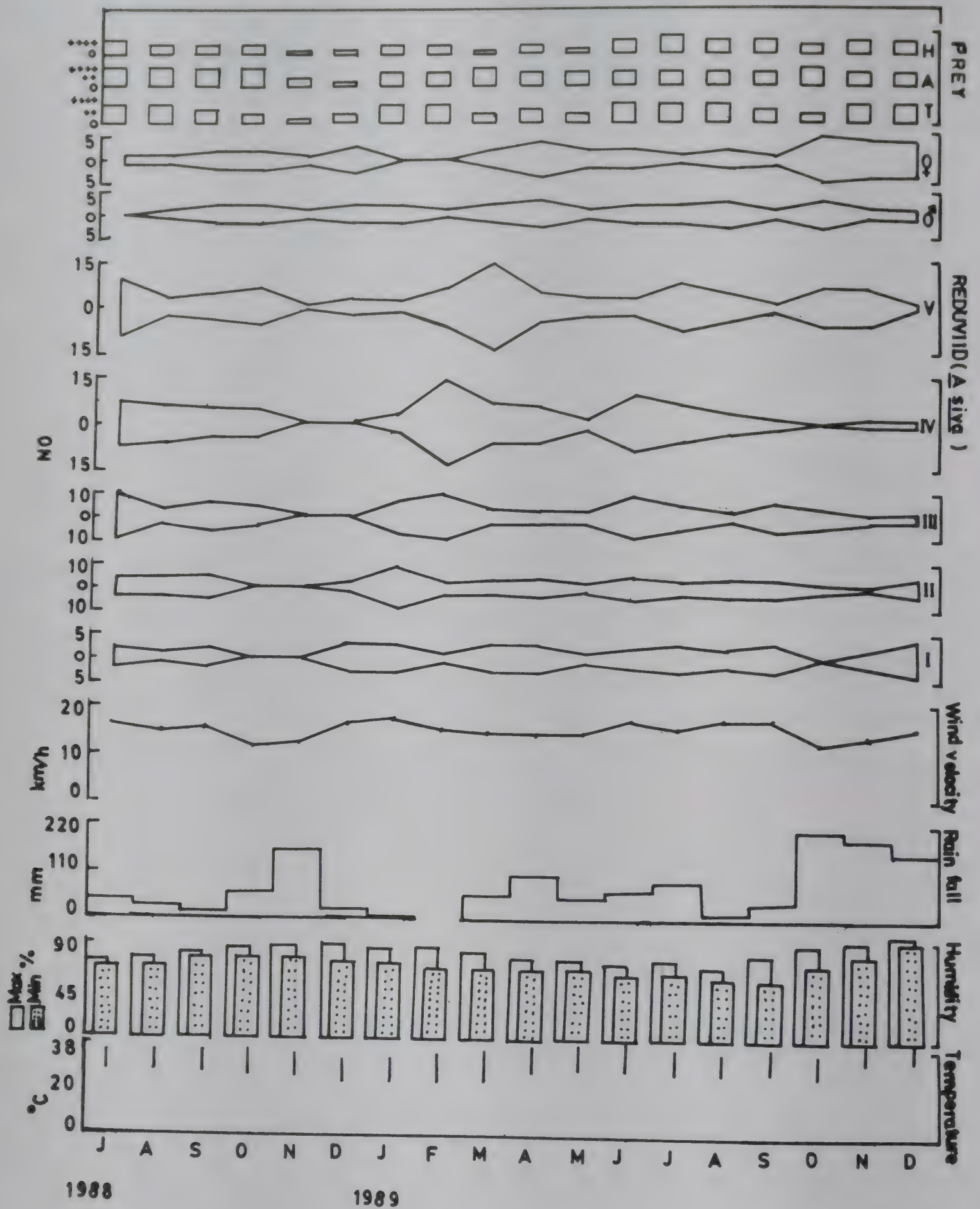


Fig. 1. Population dynamics of *A. siva* in the mainfalls area of Courtallam tropical evergreen forest (prey: H - housefly; A - ants; T - termites).



16.	<i>Sycanus pyrrhomelas</i> Walker	SC	-	-	AL	GL
17.	<i>Sycanus versicolor</i> Dohrn	SC	-	-	AL	GL
18.	<i>Lanca</i> sp.	SC	-	-	AL	GL
19.	<i>Sphedanolestes aterrimus</i> Distant	SC	-	-	AL	GL
20.	<i>S. pubinotum</i> Reuter	SC	-	-	AL	GL
21.	<i>S. aurescens</i> Distant	SC	-	-	AL	GL
22.	<i>Sphedanolestes</i> sp.	SC	-	-	AL	GL
23.	<i>Cephaloelongatus</i> sp.	SC	-	-	AL	GL
IV. SALYAVATINAE						
24.	<i>Petalochirus brachialis</i> Distant	C	+	+	AL	LS

Rostrum : S - straight; SC - slightly curved; C- curved; AC - acutely curved.

Tibial pad : (+) present; (-) absent.

Wing : AL - alate.

Eggs : GL - glued; LS - loose.

rainfall and humidity in November 1988 marked a total absence of earlier instars and lesser number of population of adults of *A. siva*. The peak in the I nymphal instar reaches high during December-January when the humidity and abundance of prey remain high. This is strengthened by the fact that in the subsequent months the population of 2nd, 3rd, 4th and 5th nymphal instars continued to remain high. A steady state is reached when adults emerge in February to March. It is significant that the population is female biased.

In *Petalochirus brachialis* the adult population remains high in the month of October when the rainfall and humidity remain high and temperature remains low (Fig.2). During February to May when the adult population remains low whereas the prey population remains uniformly high.

**2.2. Five falls area:** The onset of south-west monsoon during the month of June marks

the first appearance of harpactorine species (Fig. 3). The peak population of *Sphedanolestes pubinotum* is reached during June and September 1989. *Euagoras plagiatus* population remains high from June to November 1989 and that of *Irantha armipes* remains high from September to December. The population of *Labidocoris tuberculatus* remains during July and August when remarkable increase in the population of the millipede *Trigniules* also remains high. *Cydnocoris crocatus* rarely occurs during monsoon season.

#### DISCUSSION

Sixteen out of the twenty four species of reduviids collected from Courtallam tropical evergreen rain forest belong to the subfamily Harpactorinae. Livingstone and Ambrose (1984) also reported a similar trend.

These suggest that rainfall or higher humidity or both combined favour enhanced rate





Fig. 2. Population dynamics of *P. brachialis* from the mainfalls area of Courtallam tropical evergreen forest in relation to both biotic (prey population) and abiotic (meteorological factors) (prey: G - grasshopper; A - ants; T - termites).



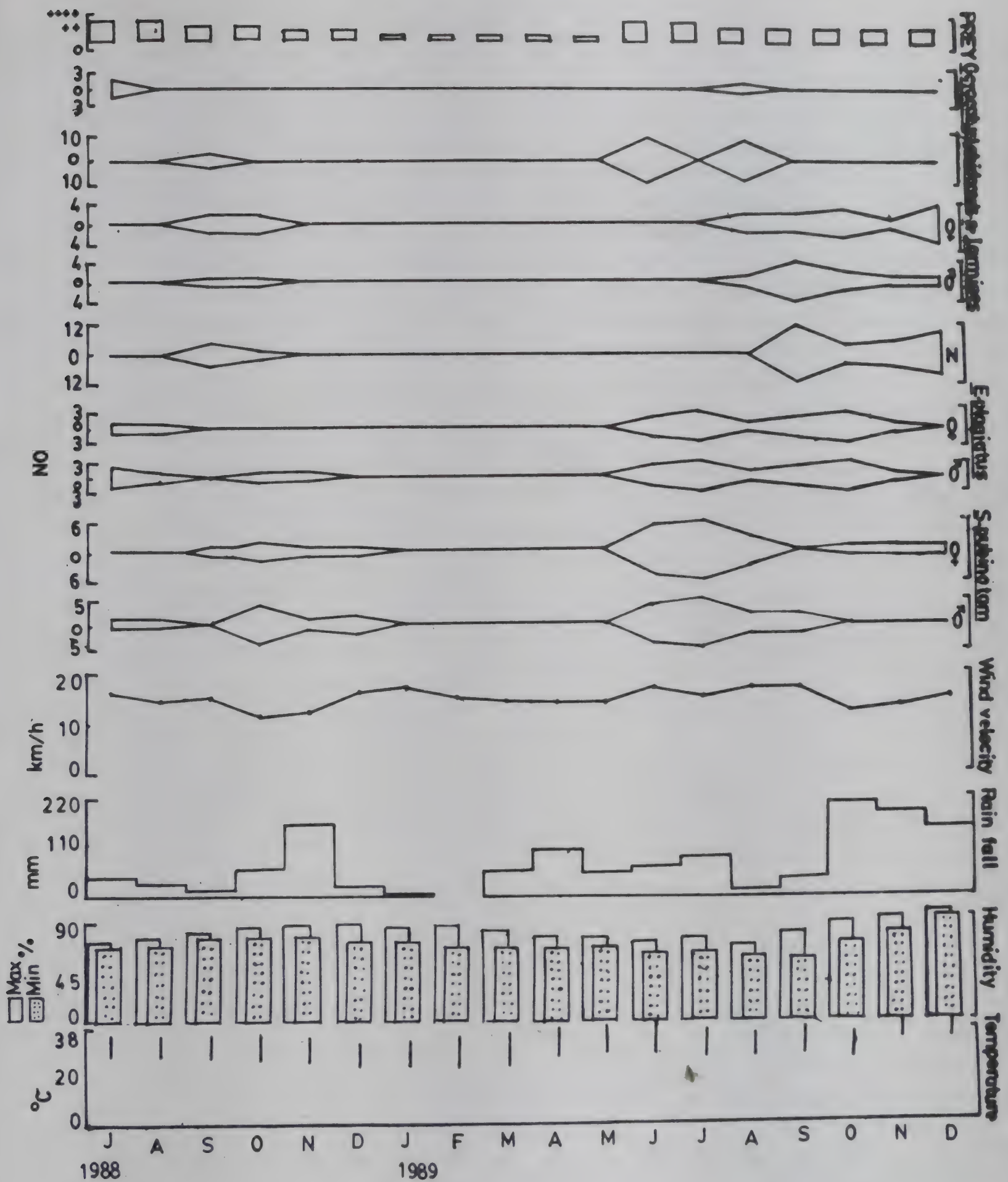


Fig. 3. Population dynamics of five species of reduviids from the Five falls area of Courtallam tropical evergreen forest in relation to both biotic (prey population) and abiotic (meteorological factors).



of hatching and the subsequent growth of younger instars. The present observation corroborates with the view maintained by Vennison and Ambrose (1990, 1991). These authors suggest that the eggs of soil inhabiting reduviids need moisture for development and dryness retards development. Haridass (1985) also observed that the reproductive activities of reduviids are restricted to the rainy seasons which synchronise with the availability of abundant specific prey types along with several other abiotic factors. The abundance of younger instars of *A. siva* is accompanied by the abundance of termites. Accordingly, the population of camponotine ants that form the staple prey for the adults also remains high. The higher adult longevity of *A. siva* may also be attributed to its abundance uniformly throughout the year when compared with the other life stages. Hence, it is quite clear that *A. siva* population is regulated by both biotic (prey) and abiotic (meteorological) factors. However, Ambrose and Livingstone (1978 and 1989) reported that the reduviid population was solely regulated by prey population.

At Courtallam, the harpactorine population is recorded only between June and December. It is mainly due to the fact that the population of caterpillars which formed the chief prey for these harpactorines are restricted only during the monsoon and post-monsoon seasons of the year. The present observation corroborates the postulation of Milne (1957a, b) that the prey population is a prey density-dependent factor for the predator. Nicholson (1958) and Clarke *et al.* (1978) also considered the density of prey population as the primary factor in controlling the population level of predators.

Contrary to the present observation on the population dynamics of *A. siva* and several other

harpactorine reduviids (where the prey population is a density dependent factor for predator) there is no direct correlation between the prey abundance and *P. brachialis* density. In the laboratory also the *P. brachialis* could not be regarded as an aggressive predator. Neither the prey nor any meteorological factor provide any concrete evidence on the behaviour of the population of *P. brachialis*. Chitty (1960) stated that the population level in a habitat is kept constant by the genetic factors of the species concerned. Pimental (1961) also considered such phenomenon as a genetic feed back in the maintenance of population level of a particular species. Hence the genetic factors may play a decisive role in the population dynamics of *P. brachialis*.

At five falls area the onset of south-west monsoon marks the appearance and the subsequent abundance of harpactorine species. The disappearance of harpactorines after December can be attributed to their migration to different locations in search of prey. Moreover, Andrewartha and Birch (1969) also correlated the dispersal of the predator with the migration in search of prey. Ambrose and Livingstone (1978, 1989) also reported similar conclusions in their population studies of reduviids.

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# DISTRIBUTION AND ABUNDANCE OF THE COMMON GARDEN LIZARD *CALOTES VERSICOLOR* IN THE MADRAS CROCODILE BANK<sup>1</sup>

SIVA R. SUNDARESAN<sup>2</sup> and R.J. RANJIT DANIELS<sup>3</sup>

(With five text-figures)

**Key words:** *Calotes versicolor*, abundance, microhabitat, Madras

Abundance, movements and microhabitat use of the common garden lizard *Calotes versicolor* were studied at the Madras Crocodile Bank over a period of 2 months in 1993. A study of 15 individually colour-marked lizards suggested that there were more males within the study area than females. 37% of the sightings of lizards were between 0900 and 1000 hours. Most of these were adult males. Adult males used arboreal microhabitats more frequently than juveniles; the latter preferring the ground. There was a greater incidence of lizards on rough-barked native trees than on smooth-barked exotics. Lizards showed considerable variability in the total area and number of trees on which they were sighted. In general the lizards seemed to avoid areas frequented by humans within the study area.

## INTRODUCTION

The common garden lizard or bloodsucker (*Calotes versicolor*) is one of the most common and widespread lizards in India. As the name suggests, this agamid lizard is common in gardens and almost any habitat from sea level to 2000 m elevation (Daniel 1983).

The fact that the garden lizard is common all over the country has made it a popular laboratory animal in schools and colleges. As a result, a lot is known of its physiology. For instance, Chandola *et al.* (1973, 1974) have studied the endocrinology of the garden lizard. Others including Deb and Sarkar (1963), Paranjape (1966-1969), Shivanadappa and Sarkar (1977), Ghate and Pal (1984) and Sharma and Shanbag (1992) have all looked into the physiology and reproductive biology while Tiwari and Schiavina (1991) worked on the morphometrics of this species. Very few

researchers have however paid attention to the natural history of this common reptile. Consequently, after the early works of McCann (1937) and Underwood (1947) there have only been a number of short anecdotal notes on this lizard such as that of Sharma (1990).

The common garden lizard due to its hardiness, easy availability, clearcut sexual dimorphism in adults and being widespread is an ideal subject for ecological studies too. Since there has not been any comprehensive ecological study made of this species in India, the present study was launched.

## STUDY AREA

The study was conducted on the campus of the Madras Crocodile Bank (12° 50' N; 80° 10' E). The crocodile bank is an 8 acre captive breeding facility and research station maintaining 8500 crocodiles belonging to 10 species. It is situated on the road to Mamallapuram, about 50 km south of Madras city. The boundaries of the crocodile bank include the Bay of Bengal on the east and Buckingham canal on the west. Between the canal and the crocodile bank is situated a small village, namely Vadanemeli Perur.

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The northern and southern boundaries are of casuarina plantations. The crocodile bank campus is well planted with trees. These include mostly *Azadirachta indica* (neem), *Albizia lebbek* and bamboo. Other species of trees include *Ficus bengalensis*, *Pongamia glabra*, *Thespesia* sp. and exotics such as *Acacia auriculiformis*, *Cassia siamea*, *Casuarina equisetifolia*, *Eucalyptus*, etc. Undershubs include *Pandanus* and a variety of garden plants. Trees and shrubs have been densely planted forming a rather continuous canopy over the otherwise barren beach sand. In general, inter-tree distances would be on an average less than 10 m over the entire campus. As a result, the ground is largely covered by a fairly thick layer of decomposing leaf litter. There are also permanent sources of fresh water within the crocodile and turtle enclosures (Fig. 1).

shade to 45°C in the sunny areas. (It is interesting that the garden lizards start laying eggs at this time in the study area). Winter temperatures go much lower and stay below 20°C at nights in December and January.

#### METHODS

The study was conducted between April and May 1993. Starting on 3rd April, the entire campus was searched during the day (0800-1600 hrs) for the presence of garden lizards. This was continued till end May covering 35 days. Whenever a lizard was sighted data was recorded as follows: time of sighting, size class (adult, subadult, juvenile), sex (not for juveniles), location and microhabitat/position (on tree, ground, walls, fences; Please see details of locations and microhabitat classification in Figs.

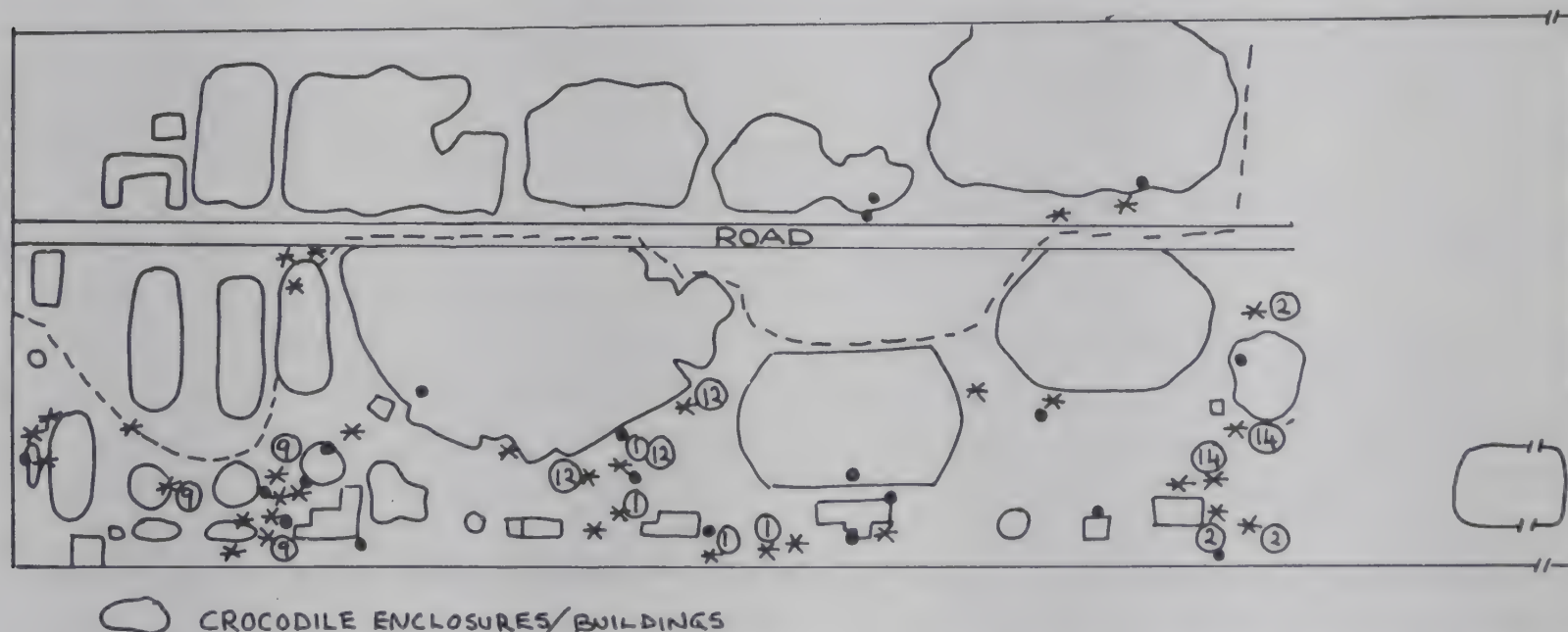


Fig. 1. Map of the Madras Crocodile Bank showing the location of trees used by lizards. Asterisks denote trees. Closed circles indicate locations other than trees. Numbers within circles indicate the lizard codes. Dashed line separates the visitors' zone - above and to the left of the line from the residential area.

The study area receives an annual average rainfall of 1600 mm most of which fall during October-November. The maximum air temperature (in the shade) goes to 40°C during May-June. During this season the maximum surface soil temperature varies from 40°C in the

1 and 4). When lizards were located on trees, the trees were marked with a coloured biodegradable band and a code number was written on the band.

One week after the initiation of the study, lizards were caught using nooses and tagged



TABLE 1  
DETAILS OF SIGHTINGS OF MARKED GARDEN  
LIZARDS

Lizard Code	Size Class/sex	No. of days seen	Trees used
C01	Adult male	5	4
C02	Adult male	6	4
C03	Adult male	1	1
C04	Adult male	2	1
C05	Adult male	1	1
C06	Adult male	1	1
C07	Adult male	1	1
C08	Young male	2	2
C09	Adult male	15	8
C10	Adult male	1	1
C11	Young male	1	1
C12	Adult male	3	3
C13	Adult male	2	1
C14	Adult male	19	3
C15	Young male	1	1

with coloured beads. A pair of beads were attached to the dorsal side of the neck using a steel wire pierced through the skin. Beads of different colours in combination enabled the use of several colour codes in identifying lizards. A total of 15 individuals were thus colour marked and their movements were monitored during the study.

The locations where lizards were seen were marked on a map (Fig. 1). Wherever necessary, inter-tree distances were measured for those trees used by any individual. Population of lizards was estimated based on the actual number caught

and marked and by individually identifying the unmarked lizards by size, colour, location and other clues such as tail injuries and characteristic colour patterns.

## RESULTS

During the study it was estimated that a total of 37 garden lizards including 22 adult males, 9 subadult males, 1 adult female and 5 juveniles occurred in the crocodile bank. Some individuals were seen just once while others were repeatedly noticed making the total number of sightings as 223. The maximum number of days a marked individual was sighted was 19 (Table 1).

The number of lizards seen per day varied throughout the study period. Fig. 2 suggests that after the first few days there was a drop in the number of lizards sighted per day.

Thirty seven percent of the sightings were between 0900 and 1000 hours. At all times adult males were more frequently seen than the other size classes (fig. 3).

Most of the 36 marked trees were neem trees with the exception of 4 *Albizia lebbek*, 1 *Acacia auriculiformis* and 1 *Cassia siamea* trees. All these trees had a minimum girth of 30 cm at a height of 132 cm above ground level.

In general all size classes of lizards had a preference for tree trunks as perches. However, trunks between 1 and 3 m above ground were the most preferred microhabitat. The adult males were the most arboreal while the juveniles tended to be terrestrial using the ground more frequently than any other microhabitat. Juveniles also seem to have avoided the use of tree trunks above 3 m and walls and buildings (Fig. 4). Only one adult female was sighted during the study. However, 3 adult females noticed outside the study period were found on tree trunk < 1m from the ground (1 individual), on ground (1



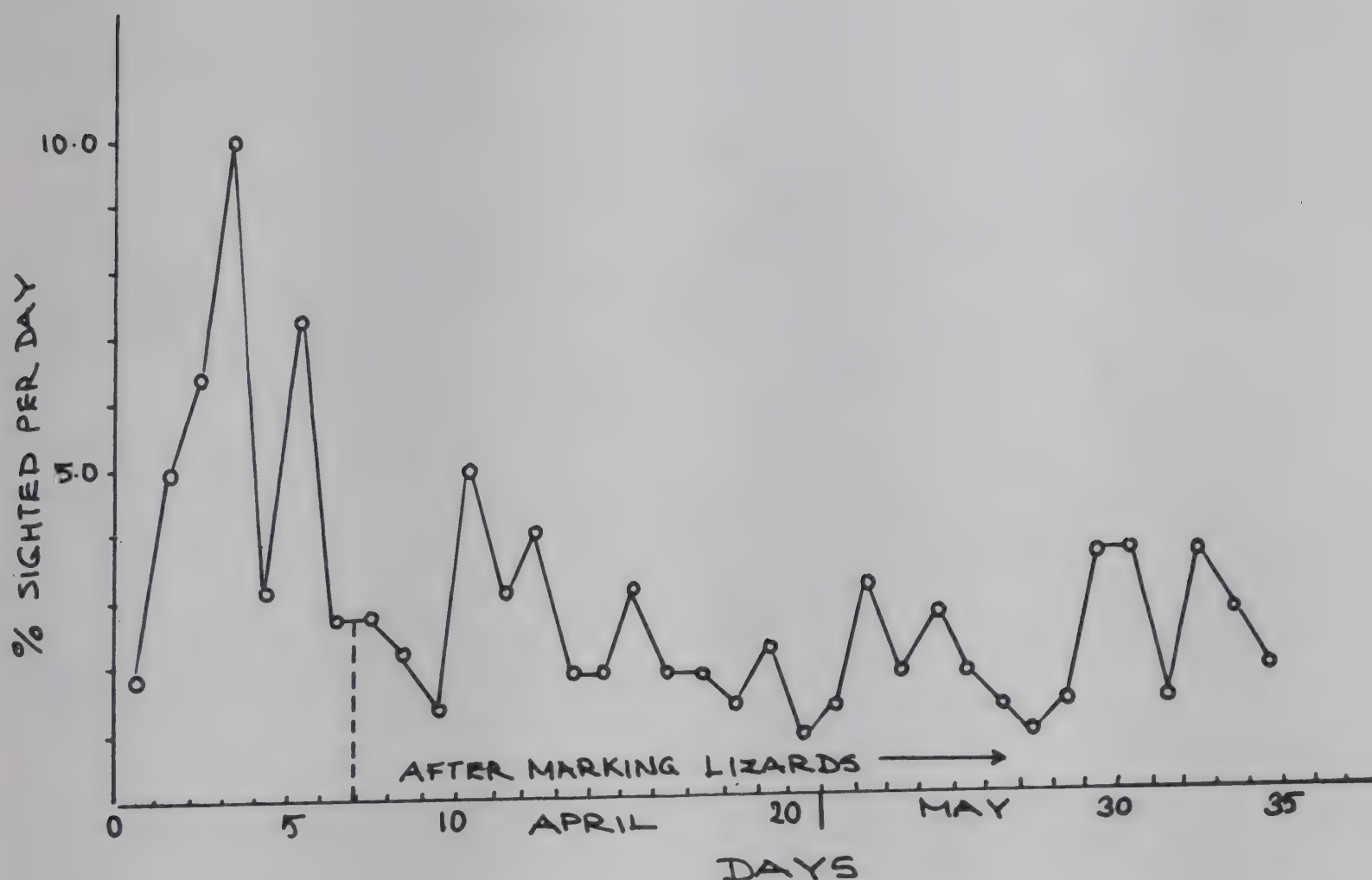


Fig. 2. Variation in the number of lizards sighted per day during the study period.

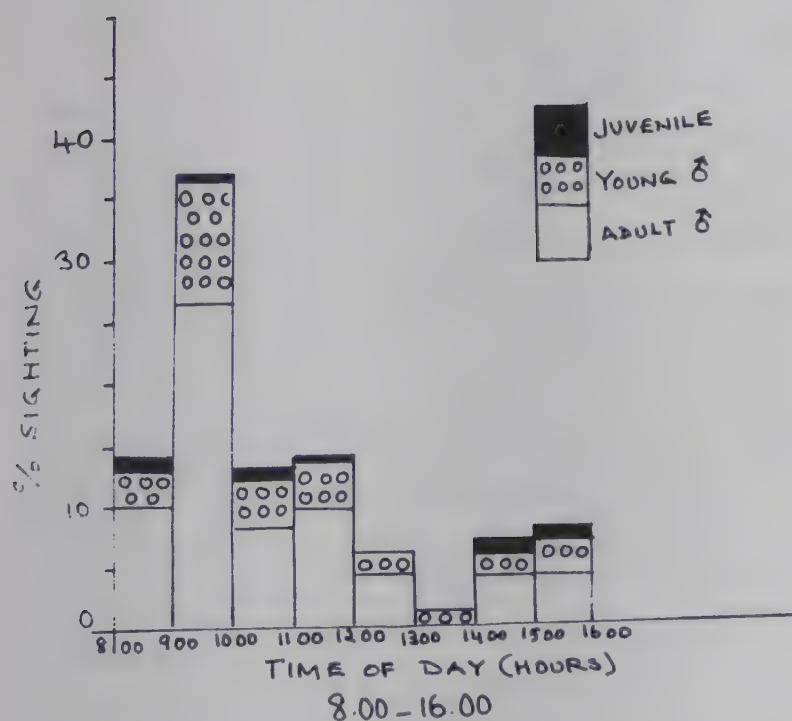


Fig. 3. Period of activity in the different age groups of lizards.

individual) and on tree 2 m above the ground (1 individual).

Fig. 1 suggests that the distribution of lizards in the study area is rather clumped. Firstly, they tend to avoid the zone open to visitors. Of the 57 locations where lizards were generally sighted, only 9 were within or close to the visitors zone. Secondly, individual garden lizards use a few proximal trees within a small radius. One lizard C09 utilized 8 different trees within an average radius of 5.42 m (the distances of each tree from a central tree were measured and averaged) and another tree 30 m away from the central tree. Lizards C01 and C012 also had a maximum dispersion of 30 m during the study. However, C2 had a maximum dispersion of 60 m. C14 showed the least dispersal tendency staying on just two trees



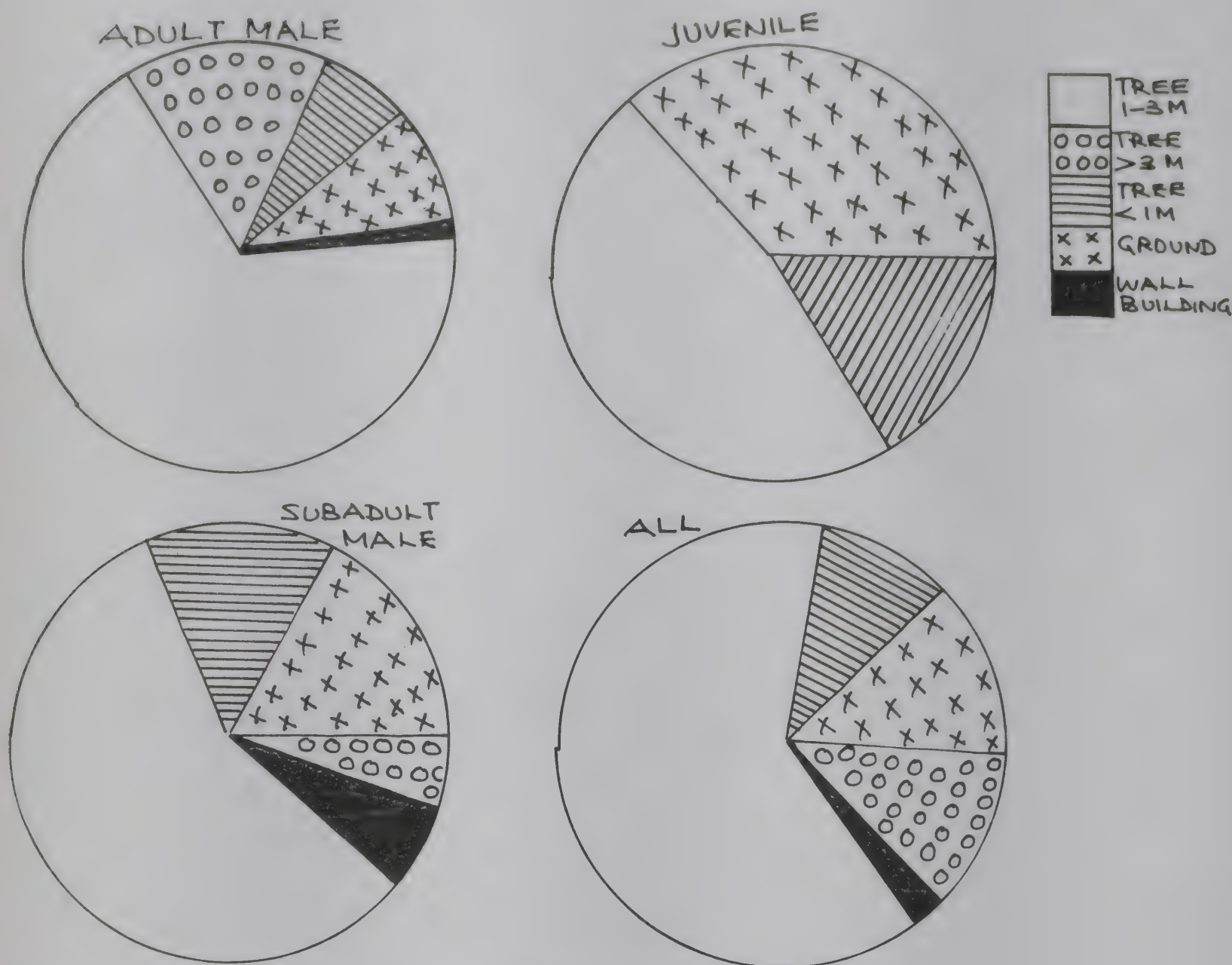


Fig. 4. Microhabitat partitioning in garden lizards.

which were less than 15 m apart. This lizard was found on the same tree on 15 occasions. Interestingly, all the lizards mentioned above were adult males.

Fig. 5 suggests that most of the marked trees were used between one and two times by a garden lizard during the study period. Of the 57 independent sightings of marked individuals, only on 3 occasions was the same tree used by two lizards.

#### DISCUSSION

The present study is the first of its kind.

Despite the fact that it was brief, the results have revealed some interesting patterns of distribution and abundance of the common garden lizard within a well defined area. In an earlier study (May-September, 1992) in the same area when 94 lizards were marked and released, it was found that there was a poor representation of adult females and juveniles in the population. It was reported that during the breeding season only 4 adult females were found nesting in and around the crocodile bank (Edward O'Keefe, unpublished data).

During the present study only one adult



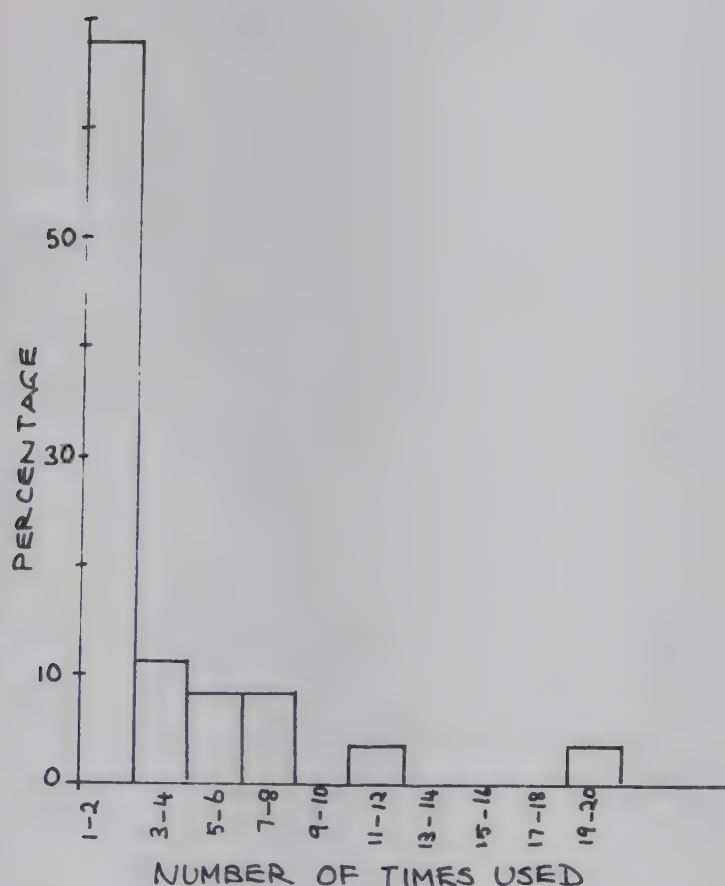


Fig. 5. Frequency distribution of number of times each marked tree was used by lizards.

female was found nesting. While there are chances that young females could be confused with subadult males, adult females are distinct with proportionately smaller heads and the dorsal crest not extending beyond the hind neck or upper back (see Goel and Reddy 1983). Confusion of sexes is more likely within juveniles when the crest has not developed. Hence the under-representation of females during the study need not be fully attributed to observer bias.

Female lizards are probably more cryptic than the males and hence not easily sampled or they move in and out of the study area during the mating and egg laying seasons. Since the present study did not fully extend into the egg laying season this hypothesis remains to be tested.

Edward O'Keefe's observation that males move about considerably explains in part the

fluctuations in the daily sighting of lizards. However, his observations on females moving into male territories could not be supported by the present study. Many of the marked males moved away in response to the handling and could never be relocated within the study area (see Table 1). This in part explains the sudden drop in number of lizards sighted per day after the marking of animals was commenced (Fig. 2).

Garden lizards though commensals of man seem to avoid highly disturbed habitats in the study area. They also show some preference for tree species. For instance, the neem trees and *Albizzia lebbek* trees are native trees with a coarse bark and associated species of ants. While there were other species in the vicinity of these trees, it is apparent that the lizards selectively chose these coarse barked trees. Neem trees are practically all over the crocodile bank forming the dominant plant species. However, the *Albizzia* trees are more scattered and localized within the study area.

A clear cut difference in the use of microhabitats by the different size classes of garden lizards is quite striking. Whether this is a response to competition for food or strategic lookout posts for mates and defending territories needs testing.

Patterns of dispersion suggest that there is individual variation. Some seem to be sedentary while others move about considerably. This may be a result of variable age structure in the population which is not readily apparent through simple body size categoration.

That very few adult females were sighted during the study induces one to speculate on the possible biased sex ratios in the species. This can possibly be a result of competition for space or a matter of predetermined bias induced at the time of hatching itself due to incubation temperatures. Thermo-Sex Determination is known in two species of agamids (Paukstis and



Janzen 1990). Issues of this sort are open for discussion and further research. While there cannot be concrete conclusions drawn from this brief study, the results leave open many interesting questions, some of which could not have been asked without the preliminary data.

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# NUMBER AND SIZE OF GROUPS OF *PRESBYTIS ENTELLUS* IN FOUR DIFFERENT HABITATS IN AND AROUND JAIPUR, RAJASTHAN<sup>1</sup>

REENA MATHUR AND B. RAM MANOHAR<sup>2</sup>

**Key words:** langurs, population, habitat

Population survey of *Presbytis entellus* in four different habitats in and around Jaipur city was carried out from 1985 to 1989. Thirty five groups of 1509 individuals formed the entire population. Langurs formed unimale (n=23), multimale (n=3) and all male (n=9) groups and the mean of the groups were 50, 40.5, 25 respectively. Group number and sizes in different habitat were different.

## INTRODUCTION

The information available on langurs in India is variable; their distribution is wide but increase in their population has only been reported from temple areas (Southwick *et al.* 1983).

The present study is the outcome of initial efforts (Mathur and Manohar 1987, Wolfe and Mathur 1987 and Mathur *et al.* 1989) followed by a detailed census survey of the primates of a city which has abundance of *Macaca mulatta* and *Presbytis entellus* (Mathur and Manohar 1990) living in different habitat.

## STUDY AREA

Jaipur (26° 55' N, 74° 55' E) is the capital of the state of Rajasthan, India. It is situated 260 km south west of Delhi at an altitude of 430 metre (above mean sea level) amidst Aravalli hill ranges. The area of the city is approximately 120 sq. km.

## METHODOLOGY

The groups of *Presbytis entellus* in and

around Jaipur were located and identified by carrying out a systematic road survey from July 1985 to December 1985 over 550 hours (approximately 3 hours a day by travelling 950 km on various roads of Jaipur; approximately 5.2 km/day). Each group was observed for 10-15 consecutive days (for 40-50 hours for identification, group size, and sex ratio). The habitat in and around Jaipur was divided into four types (1) Temple, (2) Residential, (3) Tourist, (4) Forest/village, these habitats were quantified for (i) Human disturbance, (ii) disturbance to animals, (iii) habituation to man, and (iv) presence of predators, on the basis of procedure suggested by Bishop *et al.* (1981); in addition to above four categories one more category, i.e. provisioning of food was also included. The classification and scale for first four categories have been described in detail by Bishop *et al.* (1981) and details of the fifth category are:

### Provisioning of food:

- |              |                       |
|--------------|-----------------------|
| 1. Low       | : Once in many days.  |
| 2. Moderate  | : Once in a day.      |
| 3. High      | : 2-3 times a day.    |
| 4. Very high | : Throughout the day. |

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All the study groups were identified and divided into three types, namely unimale, multimale and allmale. Overall group size, group size in different habitats and average group size separately for unimale, multimale and allmale

total of 1509 individuals formed 35 groups.

The overall degree of human disturbance in Jaipur was 2.75. Out of all the four habitats, the minimum mean score 1.8 was in forest/village and the highest disturbance was in temple/tourist

TABLE 1  
QUALITATIVE RATING OF DEGREE OF HUMAN DISTURBANCE AT FOUR DIFFERENT HABITATS IN JAIPUR

Habitat	Disturbance to habitat	Disturbance to animal	Habituation to humans	Presence of predators	Provisioning of food	Mean
Temple area (Govindeo)	4.00	2.00	4.00	3.00	4.00	3.40
Tourist area (Amber)	4.00	2.00	4.00	3.00	3.00	3.20
Residential area (Bani Park)	3.00	3.00	3.00	3.00	1.00	2.60
Forest/village (Jagatpura)	2.00	1.00	2.00	2.00	2.00	1.80
Jaipur overall	3.25	2.00	3.25	2.75	2.50	2.75

Based on criteria drawn by Bishop *et al.* (1981).

groups were calculated. The langur groups were also tabulated according to the frequency of their group sizes (0 to 30, 31 to 60, 61 to 90, 91 to 120) in four different habitats of Jaipur.

## RESULTS

During the survey, a total of 35 groups of *Presbytis entellus* were located. All the 35 groups were visited for 10-15 consecutive days. Twenty four groups were identified by identifying few individuals of each group using body cues; this way about 99 individuals of 24 groups could be identified. Eleven groups were identified by their geographical locations. Out of 35 groups, 23 were unimale bisexual, 9 were allmale and 3 were multimale bisexual groups. A

area (3.4 and 3.2 respectively; Table 1).

**Number and Types of Groups:** Maximum number of unimale groups were found in forest/village habitat and residential area and minimum in temple area (Table 2). Three multimale bisexual groups were found in areas of high provisioning, namely Ambagarh Reserve Forest, Govindeo temple and Amber, whereas, the maximum number of allmale groups were found at residential area. The residential area had 37 per cent of the total groups (inclusive of all three types), the forest/village type of habitat had 31.4 per cent, tourist and temple inhabited 20 per cent and 11.4 per cent respectively.

**Group Size:** The size of all the groups inclusive of unimale, multimale and allmale varied from 3-118. The size of groups in four



TABLE 2  
GROUPS OF HANUMAN LANGUR (*Presbytis entellus*) IN JAIPUR

Sl. No.	Habitat	Unimale	Multimale	Allmale	Total number of Groups
1.	Forest/village area	8	0	3	11
2.	Residential area	8	0	5	13
3.	Tourist area	5	2	0	7
4.	Temple area	2	1	1	4
Total		23	3	9	35

different habitats varied considerably. In the temple area it ranged from 14 to 76 with an average of 45.5 (Table 3). The smallest group was an allmale group with 14 individuals and if it was excluded, then the average group size at temple area went up to 56. The smallest group in tourist area had 26 individuals and the largest group had 80 individuals. The average group size was 44.0 (Table 3). The residential area had 13 groups in all, the smallest group had only 4 members and the largest one had 42; the average group size was much smaller than the groups found at other habitats (Table 3). Out of these 13 groups 5 groups were allmale and if, they were excluded, then the average group size in the residential area went up to 32.3.

Forest/village kind of habitat was occupied by 8 unimale groups and 3 allmale groups. The largest group had 118 members and was a unimale group (Table 3). The average group size was 61.4. If three allmale groups were not considered then the group size increased by 10 digits (71.4).

The group size varied in four different habitats (Table 3), and the analysis of variance (ANOVA) showed a significant difference among the mean group size in different habitats (Table 4). For application of 't' test between group size, two habitats were clubbed together.

The difference between average group size was significant between tourist temple area v/s residential area and also between forest/village area v/s residential area. However, no significant difference was found between the group sizes of tourist-temple area v/s forest/village area (Table 5).

**Size of the Unimale Groups:** Out of 23 unimale bisexual groups, the smallest group had 19 individuals, observed at Jhotwara in the residential area (JWUM I; Table 3) whereas, the largest group was found in forest/village area (G III; Table 3). Average group size of unimale group was 51.2.

**Size of Multimale Groups:** In 3 multimale groups, the smallest was at Amber fort (tourist area) named AMM II with 26 individuals and the largest one had 53 individuals (SMM I; Table 3) at Sisodia gardens (tourist area). Average group size was 41.3.

**Size of Allmale Groups:** The smallest group had only 3 members (G II) and the largest one was with 58 individuals (G I; Table 3) inhabiting the Ambagarh Reserve Forest (forest/village area). Average group size was 22.8.

**Frequency of groups of various sizes:** Overall, twenty per cent groups were between 51-60 size; 20 per cent groups were between



TABLE 3  
THE SIZE OF HANUMAN LANGUR (*Presbytis entellus*) GROUPS IN DIFFERENT HABITATS OF JAIPUR

Temple area		Tourist area		Residential area		Forest/village area	
Group name	Group size	Group name	Group size	Group name	Group size	Group name	Group size
GUM I	47	GAUM II	31	DAM	4	G II	3
GAM III	14	GAUM III	27	GHAM	18	SGUM	52
GMM II	45	AUM I	80	BPAM I	23	SGUM II	53
G V	76	AMM III	26	TAM II	22	G III	118
		JUM I	36	TUM I	41	G IV	102
		SMM I	53	SAUM I	38	JGUM	118
		VUM	55	JWUM I	19	KUM I	54
				JWAM II	22	G I	58
				GAUM I	42	KUM II	55
				BUM I	20	JHUM	21
				BPUM II	36	NAM	42
				DUM I	27		
				CUM	36		
Total	182 n = 4		308 n = 7		348 n = 13		676 n = 11
Mean	45.5		44		26.8		61.4
SD	25.3		19.7		11.1		37
Range	14-76		26-80		4-42		3-118

21-30; 14.3 per cent were between 31-40; again 14.3 per cent were between 41-50 group size and the smallest percentage of groups belonged to class 61-80 and to 2-10.

#### DISCUSSION

The knowledge about the population status of primates is a prerequisite to formulate any

management plan, therefore, a population survey of primates was undertaken to add information on primate resources in India.

Jaipur has population of rhesus and langurs both but the rhesus are mainly concentrated in the old city (Mathur and Manohar 1990); a density estimate separately for rhesus has already been carried out (Mathur *et al.* 1989), hence, in the present investigation, the main emphasis was



TABLE 4  
HANUMAN LANGUR (*Presbytis entellus*) UNIMALE GROUPS; ANALYSIS OF VARIANCE FOR GROUP SIZE (THE 'F' TEST) IN DIFFERENT HABITATS

Source of variation	Sum of squares	df	Mean square	F	Significance
Among means	6207.71	2	3103.855	5.16	0.05
Within sets	12024.73	20	601.236		

TABLE 5  
't' VALUES FOR GROUP SIZE IN UNIMALE GROUPS FOR THE HANUMAN LANGUR (*Presbytis entellus*) IN JAIPUR

Habitats	Means	Differences between means	't'	df	Significance
Tourist-temple v/s Resident area	50-33.8	16.2	1.82	12	0.01
Tourist-temple v/s Forest-village	50-71.6	21.6	1.48	14	NS*
Residential v/s Forest-village	33.8-71.6	37.8	2.56	12	0.01

\* NS - Not Significant.

laid on langurs.

Jaipur has all three types of groups namely unimale, multimale and allmale; however, predominantly there were unimale bisexual groups (Table 2).

The size of the multimale groups was larger than multimale groups of Melemichi and Orcha (for comparison see tables in Oppenheimer 1977, Hrdy 1977).

In the present study only 9 allmale groups were located. They were in 1:0.3 ratio with bisexual groups (multimale and unimale), however, bisexual groups have always outnumbered allmale groups (Poirier 1988). In fact, bisexual groups constituted 62 to 86 per cent of all hanuman langur groups (Sugiyama 1965, 1967; Makwana 1979, Laws and Laws

1984 and Jay 1965). The proportion of non-troop males remain low in low population density areas or in other words, proportion of non-troop males increases in relation to increasing population density. Jaipur has a density of 12.5 langurs/sq. km which is on the lower side, therefore, the number of non-troop males was also low.

The monkeys have been living with human beings in India, and have influenced each other (Oppenheimer 1977, 1978; Teas *et al.* 1981). It has been amply emphasized that human disturbance to habitat has important consequences on the demography, behaviour and ultimately the survival of non human primates, specially of the Indian subcontinent (Bishop *et al.* 1981). The present study was carried out in



and around city; the urban habitat was divided into 4 types, they differed on the scale proposed by Bishop *et al.* (1981). The findings of earlier reports that provisioning of monkeys raises the population density (Mizuhara 1964, Iwamoto 1971) is reiterated. Provisioning was highest at temple and tourist areas in the present investigation so was the density of langurs (27.1 and 31.0 respectively). On the other hand, the provisioning was least in residential and forest/village areas and so was the density (12.5; in both cases). Langur group size range from 2-3 individuals to 8-90 individuals in case of *Presbytis potenziani* (Watanabe 1981 quoted from Poirier 1988) and, in some instances as many as 125 individuals in *P. entellus* (Jay 1965, Laws and Laws 1984, Roonwal and Mohnot 1977). According to Poirier (1988) features like relative openness of the area, food availability and presence of predators influence the group size. The group size appeared to be dependent on the same three features in Jaipur as well. The forest/village habitat had the biggest group size because it provided more space and openness, the animals got enough food by exploiting plant parts of various species (scattered over a large area and were also provisioned on certain days in a week). In the forest/village habitat jackals, wolves, hyenas and feral dogs could act as predators. Collectively due to these features forest/village habitat sustained more groups and of bigger size.

Maximum number of langur groups lived in residential area (Table 2). The reason was less competition with rhesus, less human disturbance. The groups were smallest in this habitat may be because provisioning was almost nil and for food

they had to depend on trees by the road sides and house gardens etc. which were not only limited but also scattered over a large area. Temple and tourist habitat were not very different; human disturbance was higher in these two areas (Table 1) even though the average group size was the same.

The habitat sustained less number of groups as compared to residential and forest/village type of habitat, the reason could be limitation of space but the group size was bigger than groups found in residential areas and this was due to concentration of food in the form of provisioning and protection due to religious beliefs.

#### CONCLUSION

Many cities in India have fairly large number of monkeys. A systematic population survey was possible in Jaipur. Unimale, multimale and allmale groups of langurs are found in the group size ranging from 3-118. The city provides four types of habitats. The maximum number of groups were found in residential area, largest group size was found in forest/village area. Temple and tourist areas had an almost equal number of groups with equal size.

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## NEW DESCRIPTIONS

### *PARAPSILORHYNCHUS ELONGATUS*, A NEW CYPRINID FISH FROM THE WESTERN GHATS, INDIA<sup>1</sup>

DAVIS F. SINGH<sup>2</sup>  
(With two text-figures)

A new species of a hill stream Cyprinoid fish from the Western Ghats of Maharashtra is described and illustrated.

Fishes of the genus *Parapsilorhynchus* are endemic to India and are found in a few hill streams of the Western Ghats and the Satpura mountain ranges. The genus is unique in possessing a combination of characters which, in turn are diagnostic for families such as Cyprinidae, Psilorhynchidae, Homolopteridae and Gyrinocheilidae, besides having its own distinct features. A very prominent character of these fishes is the presence of a callous pad on the ventral side, just behind the lower lip, which is quite unlike that in *Garra* where it is a well developed muscular mental disc. The fish feed mainly on algal matter, which is scraped off the rocks using its sharp-edged lower jaw.

Annandale (1919) originally described a species, *Psilorhynchus tentaculatus*, from the Western Ghats, whereas Hora (1920) differentiated this species from the species of *Psilorhynchus* found in the Himalayan region and created a new genus *Parapsilorhynchus* to accommodate this species. Subsequently two more species were described, *P. discophorus* Hora (1921) from the Vasisthi valley, Ratnagiri, and *P. prateri* Hora and Misra (1939) from Deolali, Nasik district, Maharashtra. Both the localities are situated in the Western Ghats. *P. tentaculatus* has also been recorded from Satpura mountain ranges (Hora 1925). The inclusion of

this genus in subfamily Cyprininae has been reviewed recently (Yazdani and Singh 1990).

While searching for topotype specimens of the endemic fishes of the Western Ghats, I made extensive surveys of the hill streams originating in these mountain ranges. In one collection from the Ghod river, a tributary of Bhima river (a Krishna river drainage), 4 specimens of *Parapsilorhynchus* were obtained which differ markedly from all the species so far known. The new species is described in this paper.

The collection was made with a bag net and the specimens have been preserved in 5% formalin. Measurements (in mm) were made with calipers. Alizarin preparation was made for studying the osteological details. The specimens are presently kept in Salim Ali Centre holdings.

Since this species belongs to an endemic genus and probably have a very small natural population, only 4 specimens were collected for taxonomic studies.

#### Genus *Parapsilorhynchus* Hora

1921 *Parapsilorhynchus* Hora, Rec. Indian Museum 22:13-17.

(Type: *Psilorhynchus tentaculatus* Annandale)

1925 *Parapsilorhynchus* Hora, Rec. Indian Museum 27(6):457-460.

1978 *Parapsilorhynchus* Babu Rao & Yazdani, Bull. Zool. Surv. India 1(2):129-133.

1990 *Parapsilorhynchus* Yazdani & Singh, Rec. Zool. Surv. India 88:1-4.

<sup>1</sup>Accepted February 1994.

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***Parapsilorhynchus elongatus* sp. nov.**  
(Fig.1)

**Types:** *Holotype* - SACON Reg. No.P/3. 41 mm SL. Locality: Ghod river. Khondwal village, Ambegaon taluka, Pune district, Maharashtra state, India. Altitude 980 metres above sea level. Latitude 19° 04'N, Longitude 73° 32'E. Collected by D.F.Singh.

*Paratypes* - 3 specimens. Reg. No. P/4. Same locality.

**Etymology:** The species name "*elongatus*" is derived from the Latin meaning extended. The name is in reference to the extended pectoral fin.

**Diagnosis:** Distinguished from other species of *Parapsilorhynchus* by its more elongate body, pectoral fins larger than head length with 3

simple and 10 branched rays. Lateral line scales 36, lateral transverse scales 8. Eyes are visible from below.

**Description** (based on the Holotype): D III, 7; P III, 10; V 9; A II, 5; C 24; L.1. 36; L.tr. 4 1/2-3 1/2.

Body elongate and somewhat cylindrical, ventral surface flattened. Body depth 5.8 times in SL. Head depressed with a prominent snout. Mouth small, crescent-shaped with upper lip fringed. A groove present around the corners of the mouth which is continuous anteriorly round the outer margin of the rostral fold. Lower lip bilobed, with a small callous thickening behind it. Single pair of rostral barbels. Eyes large, visible from below. Dorsal fin inserted opposite ventral fin. Caudal fin forked with rounded

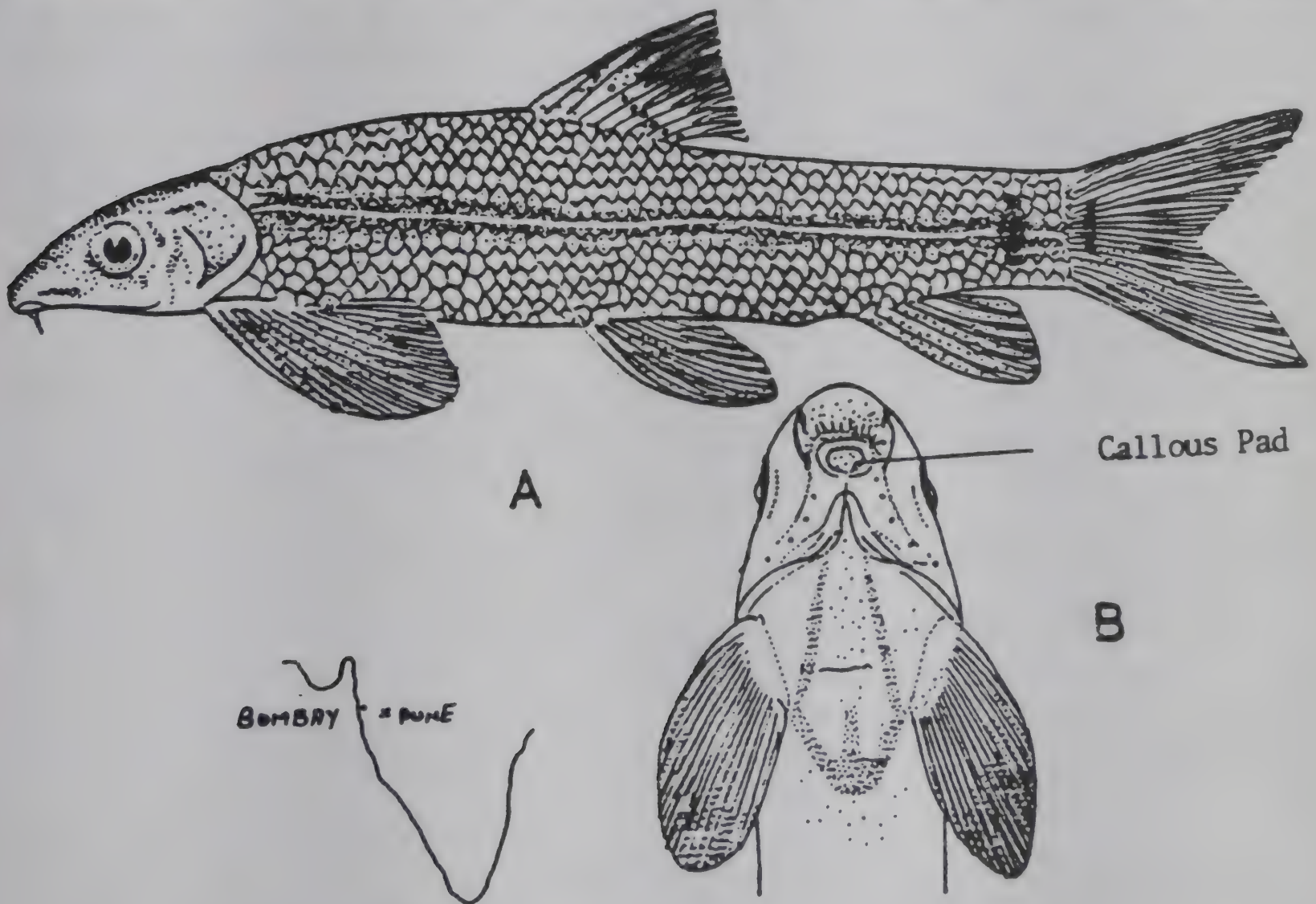


Fig. 1. *Parapsilorhynchus elongatus* sp. nov. A. Lateral view; B. Ventral view.



TABLE 1  
MORPHOMETRIC MEASUREMENTS IN *P. elongatus*  
SP. NOV.

Proportion	Range	Mean
Total length/Standard length (TL/SL)	1.2-1.29	1.23
SL/Head length (HL)	4.1-4.55	4.32
SL/Body depth	5.8	5.8
SL/Predorsal length	1.78	1.78
HL/Snout length	2.5-3.0	2.75
HL/eye diameter	3.3-4.5	3.9
HL/Interorbital width	1.5-1.66	1.58
HL/Pectoral fin length	1.32-1.33	1.32
TL/HL	5.3-5.55	5.42
TL/Body length	7.57-7.14	7.35
TL/Predorsal length	2.17-2.30	2.23

lobes. Scales small. Lateral line scales 36. Lateral transverse scales 8. Head length 4.55, body depth 5.85 in SL. Eye diameter 4.5, Interorbital width 1.5, snout length 3.00 in HL. Predorsal distance 1.78 in SL. Length of pectoral fin 1.33 in HL. Distance from ventral fin to anus 5.85 and from anus to anal fin 13.66 in SL. Further data is presented in Table 1.

Coloration (in life): Head and body brownish, paler above and below the mid-lateral region. Ventral surface white. A black horizontal bar or spot on the caudal peduncle. Fins whitish. Each branched ray of dorsal with a black spot. Caudal with a vertically oval black spot at its base.

The urohyal bone (Fig.2): To further confirm the findings, the urohyal bone of *P. tentaculatus* and *P. elongatus* sp. nov. were

studied. The urohyal is a single bone, the anterior tip of which is connected to the ventral hypohyal and the posterior part connected to the pectoral girdle by a large muscle. It is a functional bone in fishes and its position is related to the functional differences of the mouth-opening mechanism. Chabanaud (1933a, 1933b), Kyle (1921), Dutt and Rao (1965) and Kusaka (1974) emphasised the taxonomic importance of the urohyal.

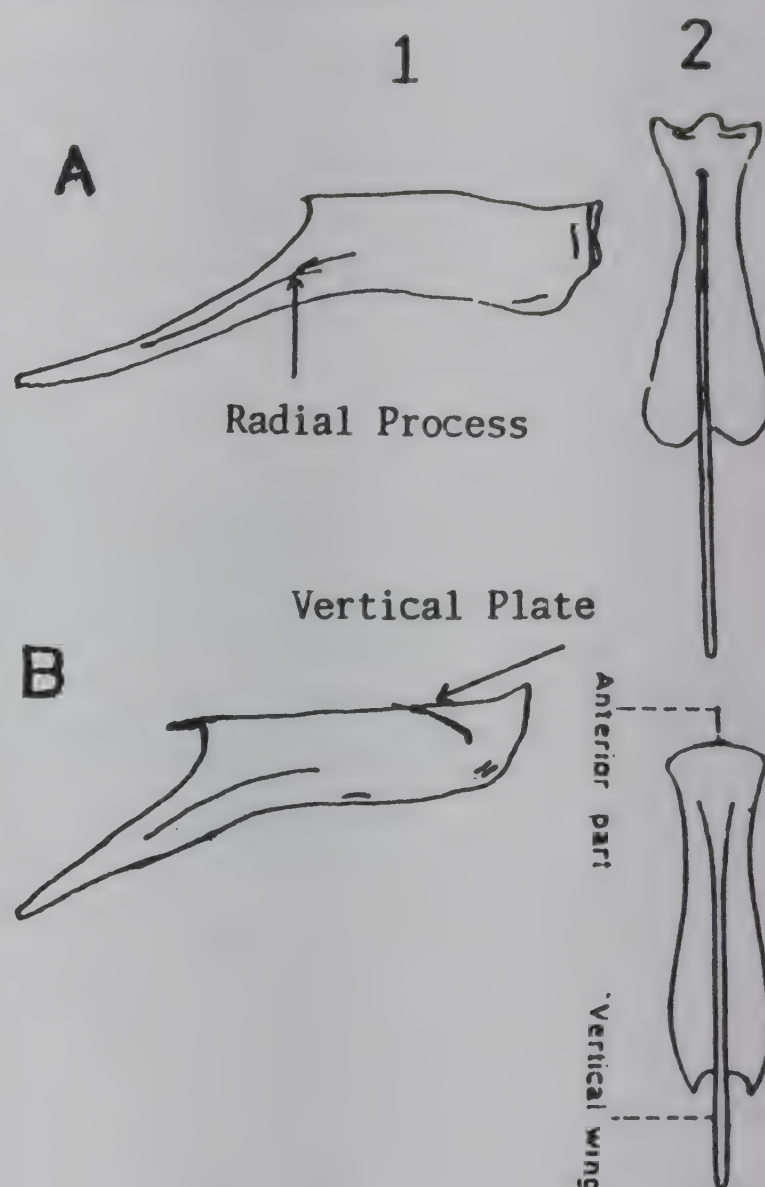


Fig. 2. Urohyal: 1. Lateral view; 2. Dorsal view.  
A. *P. elongatus* sp. nov.; B. *P. tentaculatus*.

In the present species, although the urohyal (Fig. 2) exhibits the usual cyprinid conformation, the vertical plate extends posteriorly into a long tapering process. The dorsal process does not



have sharp edges as in *P. tentaculatus*.

## KEY TO SPECIES

1. (a) Scales rather minute, 43 to 47 in lateral line; lateral transverse scale-rows about 12; depth of body 5.3 to 6 times in standard length. . . . . *P. prateri*
- (b) Scales small, 33 to 39 in lateral line; lateral transverse scale-rows 8 to 10; depth of body 4 to 5 times in standard length. . . . . 2
2. (a) Pectoral fin with two unbranched (simple) rays; lower lip with a distinct disc behind it; lateral line scales 33 to 35; eyes small, 4 to 6% of standard length, distinctly visible from underside of head. . . . . *P. discophorus*
- (b) Pectoral fin with 3 simple (unbranched) rays; posterior part of lower lip merely thickened

- without forming a distinct disc. . . . . 3
3. (a) Lateral line scales 36-39; eyes not visible from underside of head; pectoral fin length 0.7 times and eyes 2.5-3.5 times in head length; body depth 4.7 times in standard length. . . . . *P. tentaculatus*
- (b) Lateral line scales 35-36; eyes visible from underside of head; pectoral fin length 1.33 and 4.5 times in head length; body depth 5.8 times in standard length. . . . . *P. elongatus* sp. nov.

## ACKNOWLEDGEMENT

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SEVEN NEW SPECIES OF TINGIDAE FROM SOUTHERN INDIA<sup>1</sup>

DAVID LIVINGSTONE AND S. JEYANTHIBAI<sup>2</sup>  
(With seven text-figures)

Seven new species of Tingidae have been described : *Corythauma gibbosa* on an unidentified shrub; *Dictyla hessarghattaensis* on *Cynoglossum denticulatum* (Boraginaceae); *Eteoneus cinchonaensis* on *Colebrookia* sp. (Labiateae); *Physatocheila asiatica* on *Gmelina asiatica* (Verbenaceae); *Stephanitis cinnamomae* on *Cinnamomum* sp. (Lauraceae); *Stephanitis macranthai* on *Persea macrantha* (Lauraceae); and *Tingis premnae* on *Premna tomentosa* (Verbenaceae).

## INTRODUCTION

After the publication of the tingi-fauna of the Indian subcontinent by Distant (1904 & 1910), Drake (1933), for the first time, described a few more new species of Tingidae from Southern India. Subsequently, some more new species were discovered by Drake. In their world catalogue of Tingidae, Drake and Ruhoff (1965) listed 99 species belonging to 49 genera and 2 subfamilies from India. Drake and Mohanasundaram (1961); Drake and Livingstone (1964), Livingstone (1972) and Livingstone and Jeyanthibai (1993) added a few more species, making a total of less than 120 species of Tingidae so far known from India. In the present paper seven more species are described from southern India. At present the types are in the collections of the senior author.

## DESCRIPTION OF SPECIES

1. *Corythauma gibbosa* sp. nov.

Measures 3.0 mm long and 1.4 mm broad, stramineous.

**Head:** Dark brown; almost entirely concealed by the pronotal hood; all five

cephalic tubercles short, testaceous; antennae slender, stramineous; III, IV segments clothed with long fine hairs; proportionate lengths of antennomeres 1:0.53:3.9:2.3; antenniferous tubercles small, porrect, testaceous; eyes piceous; rostrum stramineous, passing the middle of mesosternum; rostral tip testaceous; sternal furrow narrow, deep, closed; sternal lamina uniseriately areolate; bucculae broad, triseriately areolate, occluding almost completely the basirostral segment.

**Thorax:** Pronotum ferrugineous; gibbose; tricarinate, median carina uniseriately areolated, raised anteriorly forming the massive gibbose areolated hood, almost concealing the head, up to the eyes, posteriorly merging with the areolations of the obtuse scutellum; lateral carinae parallel, anteriorly terminating a little behind the hood, posteriorly terminating at the base of the scutellum; hemelytra dark brown passing abdomen, slightly constricted subapically; apices overlapping and jointly rounded; subcostal area stramineous midway, triseriately areolate with irregular areolae, confluent with postcubital area; radial area biseriately areolate, confluent with the sutural area; discoidal area triseriately areolate; clavus basally biseriately areolate, distally uniseriately areolate; hypocostal lamina uniseriately areolate, passing the middle of the radius; hemelytral margins, subcostal and discoidal areas sparsely covered with short hairs; legs stramineous; femora slightly incrassated;

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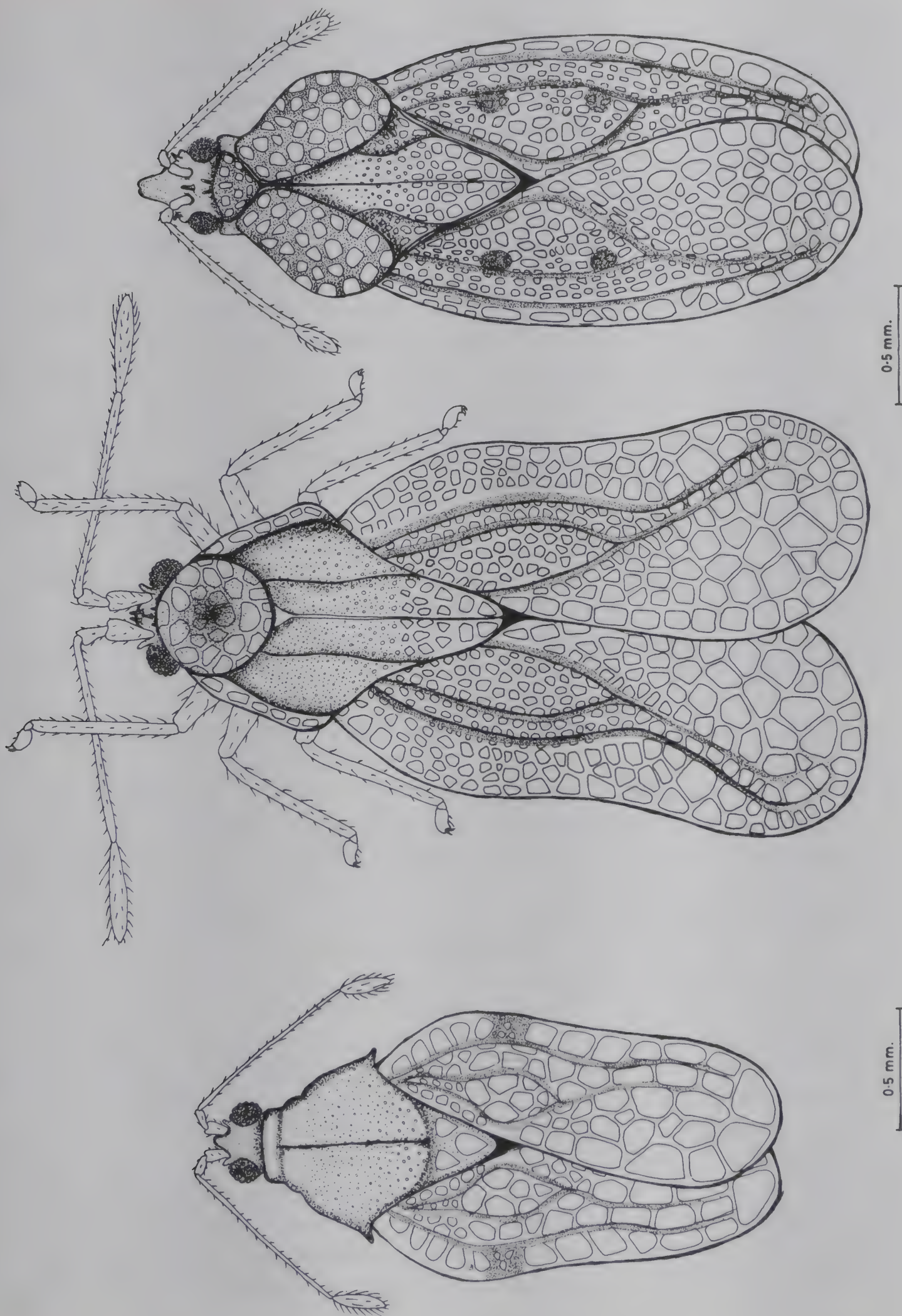


Fig. 3. *Dictyula cinchonaensis* sp. nov.;

Fig. 1. *Dictyula gibbosa* sp. nov.;

Fig. 2. *Dictyula hessarghattaensis* sp. nov.



distitarsus dark brown, ventrally beset with a cluster of spatulate hairs.

**Notes:** *Corythauma gibbosa* sp. nov. closely resembles *C. ayyari* Drake, but it can be readily identified from the latter by the largeness of its size and its hood, longer antennae, uniseriately areolate paranotum and triseriately areolate subcostal area. The genus *Corythauma* Drake and Maa, with the type species *C. ayyari* (*Leptopharsa ayyari* Drake) on *Jasminum pubescens* from Southern India, is known only from India. The second species *C. varia* Drake and Maa (1953) without any host record, is regarded as a variety of *C. ayyari*, that causes leaf curl gall in *Jasminum pubescens* (Livingstone 1962). *Corythauma gibbosa* is therefore the third species of this genus recorded in South India.

**Materials examined:** *Holotype*: female, macropterous; 13.6.1981; Courtallum, Thirunelveli, Tamilnadu; on undetermined shrub. *Paratypes*: five specimens; data as of holotype.

## 2. *Dictyla hessarghattaensis* sp. nov.

Measures 3.09 mm long, 1.05 mm broad; piceous; two conspicuous spots, one on the vein separating discoidal area from radial area and the other at the junction of media and cubitus.

**Head:** Piceous, very short; sharply declivent in front of the eyes; loral tubercles absent; frontal and postgenal tubercles rudimentary, stramineous; antennae moderately elongate, slender; first three segments stramineous, inconspicuously pubescent; segment IV subclavate, ferrugineous, densely packed with long stiff hairs; proportionate lengths of antennomeres: 1:1.2:7.7:3.3; antenniferous tubercles moderately elongate, ferrugineous; eyes piceous; rostrum passing metasternum; sternal furrrow deeply grooved, closed; sternal lamina narrow, uniseriately areolate; bucculae greatly

enlarged, five areolae deep, almost completely occluding the basirostral segment.

**Thorax:** Pronotum gibbose, densely punctate anteriorly; tricarinate, median carina uniseriately areolate, anteriorly terminating as hood, 8-9 areolae deep on either side, covering the posterior half of the head as well as the eyes and posteriorly merging with the areolations of the scutellum; lateral carinae sinuous, uniseriately areolate, slightly diverging towards the paranotum, abruptly terminating posteriorly at the base of the scutellum on either side of the median carina; paranotal expansion much enlarged, six areolae deep, fully reflexed on the pronotum leaving medially a narrow space on either side of the median carina; hemelytra passing abdomen; apices partially overlapping with one another, subcostal area narrow, uniseriately areolate, subapically biseriately areolate, transparent, rectangular areolae alternating with subquadrate ones; apically confluent with the post cubitus; radial area triseriately areolate, confluent with the sutural area, sloping obliquely downward towards subcostal area, five to six areolae deep just behind discoidal area and terminating distally into a single cell; discoidal area five areolae deep at the middle; media and cubitus with a tumid elevation; sutural area infuscated; hypocostal lamina uniseriately areolate; clavus biseriately areolate; legs long, slender; femur fuscus; rest of the legs stramineous; distitarsus terminally ferrugineous.

**Notes:** *Dictyla hessarghattaensis* sp. nov. resembles *D. eudia* Drake and Quadri (1964), but differs from it by the largeness of its size and longer flagellar segments. Out of the 68 species of *Dictyla* Stål known in the world, only three species are recorded from India (Drake and Ruhoff 1965). This genus was placed earlier with *Monanthia* which is now suppressed.

**Materials examined:** *Holotype*: Female,



macropterous; 18.12.1979; Hessarghatta (Karnataka); *Cynoglossum denticulatum* (Boraginaceae). *Paratypes*: Fifteen specimens; data as holotype.

### 3. *Eteoneus cinchonaensis* sp. nov.

Measures 2.34 mm long and 0.75 mm broad; piceous; pronotum anteriorly piceous; hemelytra with a median cross band.

**Head:** Fuscus, shiny, absolutely bare; antennae slender, pilose; first two segments subequal, bare; III and IV segments fringed with long stiff spines; proportionate lengths of antennomeres; 1:1.6:10.8:4; antenniferous tubercles minute, rudimentary; eyes large, wide apart, piceous; rostrum stramineous, passing metasternum; sternal lamina rudimentary, open posteriorly, non areolate; sternal furrow narrow; bucculae fairly broad, oper, biserially areolate, fringed with stiff hairs, partially occluding the basirostral segment.

**Thorax:** Pronotum gibbose, coarsely punctate, unicarinate, carina, median, non-areolate, anteriorly merging with the truncated collar and posteriorly merging with the areolations of the scutellum; paranotum wanting; lateral margins fringed with stiff hairs; scutellum with two to four large areolae; hemelytra with darkly pigmented, uniserially areolate subcostal area; 3-6 smaller areolae pigmented, the rest of the areolae large and transparent, confluent with the postcubital area; radial area basally biserially areolate, at the middle triserially areolate; distally confluent with the sutural area; discoidal area biserially areolate with two large areolae at the middle and with a single row of incomplete areolae; sutural area narrow, infuscated; radial and discoidal areas both merged by two tumid elevations, anterior one at the middle of media and posterior one at the junction of media and cubitus; clavus with a

single areola; outer margin of the hemelytra fringed with filiform hairs; legs stramineous; femur and tarsomeres testaceous and elongated.

**Notes:** *Eteoneus cinchonaensis* sp. nov. closely resembles *E. dilatatus* Distant, but differs by its smaller size and shorter antennomeres. It can be separated from *E. angulatus* Drake and Maa by its smaller size; uniserially areolated subcostal area and biserially areolated radial and discoidal areas. The type species of this genus was *Serenthia dilatata* Distant from Taiwan. The only other species known from India is *E. sigillatus* Drake and Poor.

**Materials examined:** *Holotype*: male; macropterous; 8-4-1981; Cinchona, Tamilnadu; *Colebrookia* sp. (Labiatae). *Paratype*: Twenty specimens; data as of holotype.

### 4. *Physatocheila asiatica* sp. nov.

Measures 2.88 mm long and 1.08 mm broad; stramineous; pubescent; body beneath testaceous.

**Head:** Testaceous, all five cephalic tubercles testaceous, short, blunt, loral pair more porrectly produced in front of the head; antennae testaceous, pubescent; I and II segments subequal; proportionate lengths of antennomeres; 1:0.66:2.6:1.3; antenniferous tubercles short and testaceous; eyes fuscus; rostrum passing mesosternum; sternal lamina nonareolate, posteriorly broad and open.

**Thorax:** Pronotum convex; anteriorly testaceous; tricarinate, carinae raised, uniserially areolate, closely pitted; median carina anteriorly forming the areolated gibbose hood; posteriorly merging with the areolate, acutely pointed, stramineous scutellum; lateral carinae sinuous, anteriorly arising on either side of the hood and posteriorly terminating at the base of the scutellum; paranotum moderately broad, three areolae deep, reflecting back on the pronotum



and marginally raised vertically upward; hemelytra with overlapping sutural area, rounded apically, passing abdomen; subcostal area uniseriately areolate, posteriorly closed; radial area uniseriately areolate, confluent with the sutural area; discoidal area four areolae deep at the middle; sutural area broad with smaller areolae; hypocostal lamina uniseriately areolate; clavus distally uniseriately areolate, proximally biseriately areolate; margin of the hemelytra, subcostal, radial and discoidal areas densely packed with small setose hairs; such hairs sparsely distributed in the sutural area; leg brownish pubescent.

**Notes:** *P. asiatica* sp. nov. can be readily recognized from the other south Indian species *P. chatterjeei* Drake and Poor by its coloration, length of the cephalic tubercles; triseriately areolate subcostal and radial areas. It can be distinguished from *P. dryadis* Drake and Poor by the nature of its antennomeres, triseriately areolate paranotum and uniseriately areolate subcostal and radial areas. In *P. dryadis* these areas are described as biseriately areolate.

**Material examined:** *Holotype*: male, macropterous; 8-6-1979; Marudhamalai (Coimbatore); *Gmelina asiatica* (Verbenaceae). *Paratype*: Five specimens; data same as of holotype.

##### 5. *Stephanitis cinnamomae* sp. nov.

Measures 3.4 mm long, 1.2 mm broad; whitish testaceous.

**Head:** Very short, strongly declivent in front, fully concealed by the hood of the pronotal median carination, exposing the eyes; all the five cephalic tubercles (2 lorae, 1 frontal and 2 postgenal) correctly passing the head, but concealed by the hood; antennae long, slender, stramineous; proportionate lengths of

antennomeres 1:0.2:3.8:1.6; antenniferous tubercles minute; eyes fuscus; bucculae biseriately areolate, open, marginally serrated, fringed by minute soft hairs; rostrum stramineous, passing mesosternum, rostral furrow broad, laminae nonareolate, posteriorly closed.

**Thorax:** Pronotum slightly convex; finely punctate; tricarinate, median carina longest, biseriately areolate, areolae enlarged anteriorly as the acutely pointed hood, extending far beyond the head, posteriorly merging with the scutellum; lateral carinae small with two areolae; scutellum narrow, acutely tapering posteriorly; paranotum greatly expanded, reflexed, directed vertically upward, three areolae deep in the middle, serrated marginally, border spinous; elytra passing abdomen, constricted at the middle; subcostal area broad, confluent with the postcubital area, four areolae deep at the broadest region; radial area biseriately areolate, confluent with the sutural area; discoidal area very narrow, 3-4 areolae deep at the broadest region; clavus with a single areola; outer margin of elytra finely serrated, beset with minute hairs; a few cells at the apical region of the subcostal area and discoidal area darkly pigmented; legs very long, slender, stramineous; tibia and tarsomeres terminally testaceous.

**Notes:** *S. cinnamomae* sp. nov. can be readily recognized from *S. charieis* Drake and Mohanasundaram by its strongly reflexed, vertically directed paranotum; it can be further recognized from *S. macranthai* sp. nov. by its reflexed paranotum having 3 rows of cells.

**Material examined:** *Holotype*: female, macropterous; 4-9-1981; Cinchona (Valparai), Coimbatore; *Cinnamomum* sp. (Lauraceae). *Paratype*: Seven specimens; data same as of holotype.



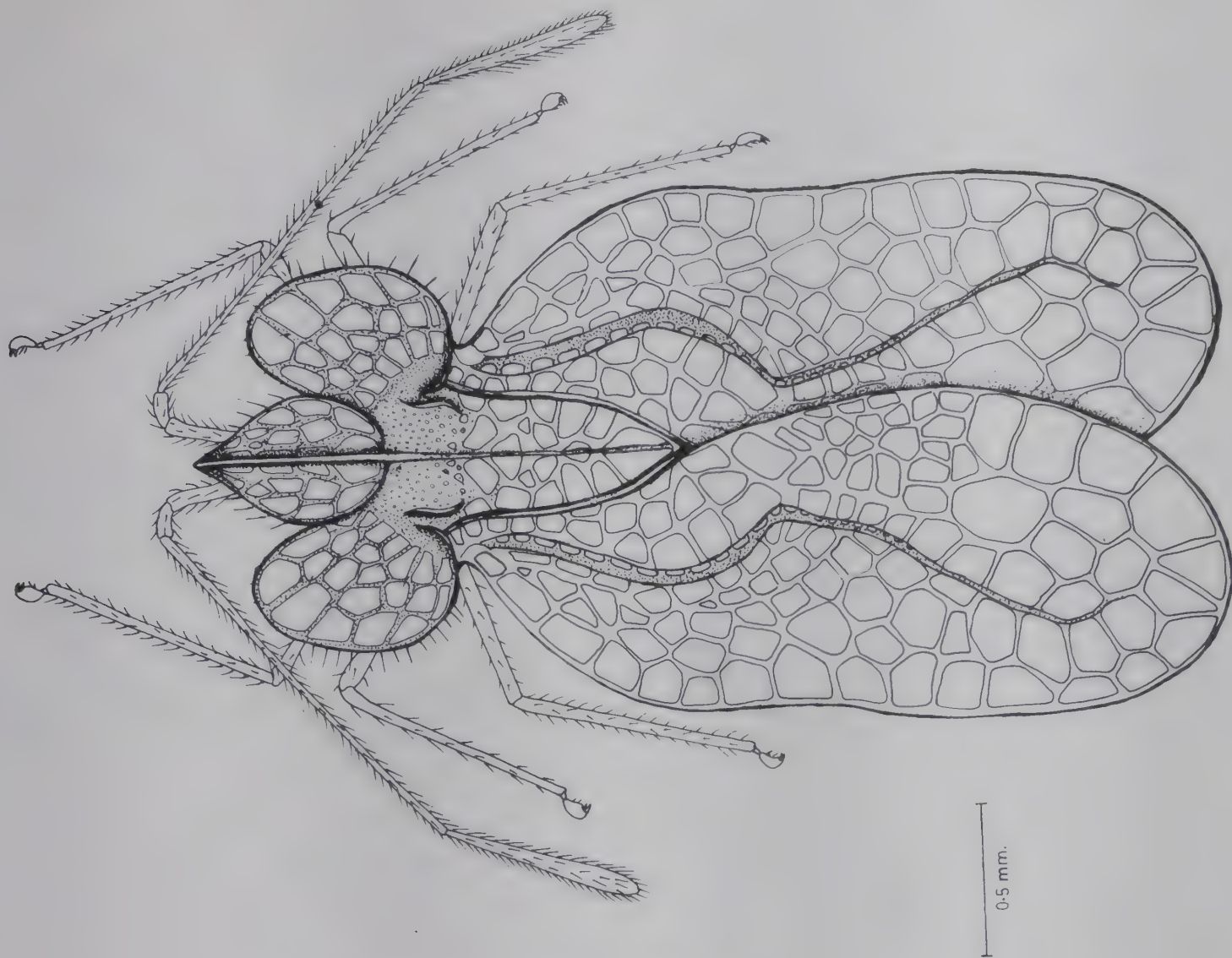


Fig. 6. *Stephanitis macranthai* sp. nov.

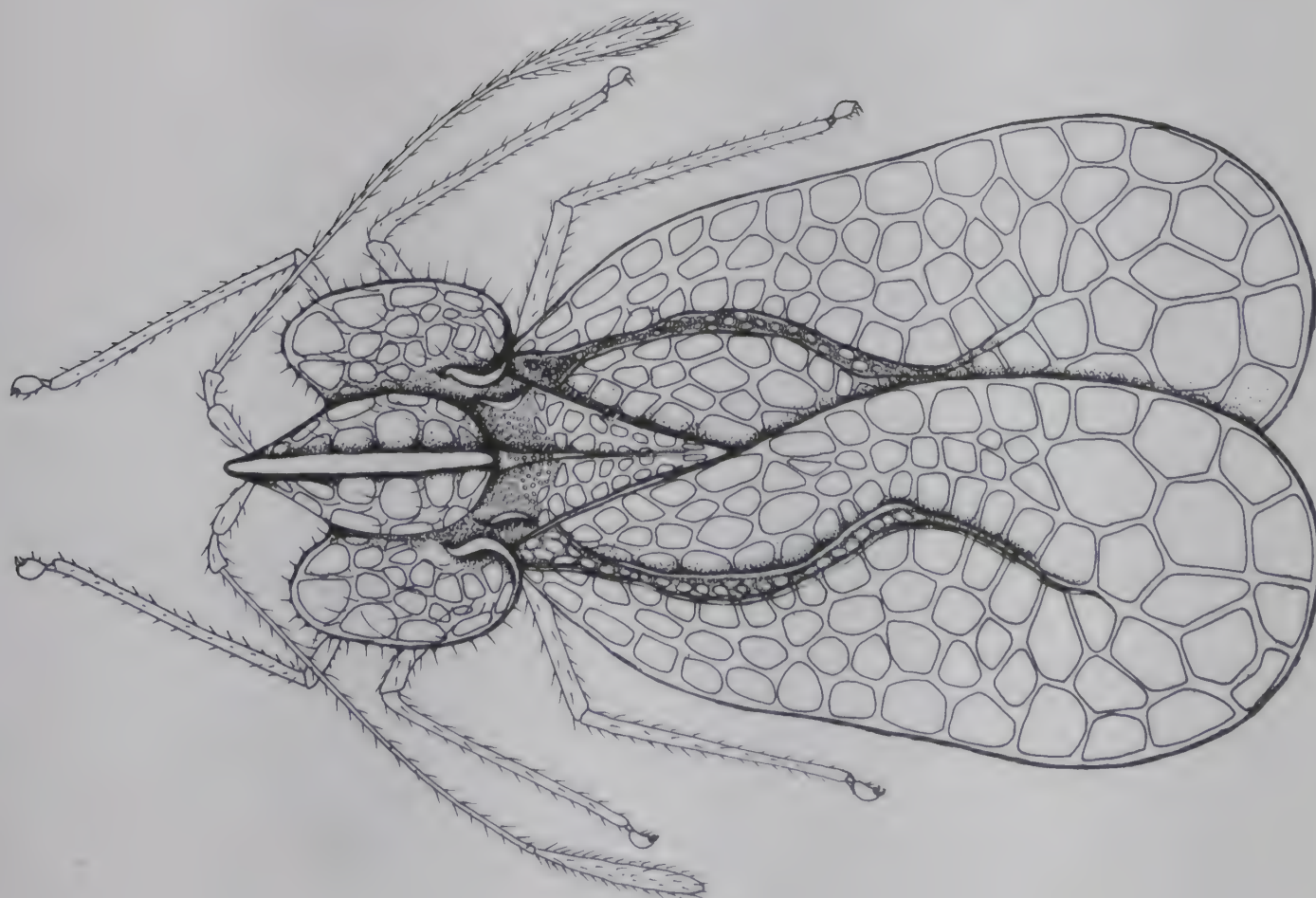


Fig. 5. *Stephanitis cinnamomae* sp. nov.;



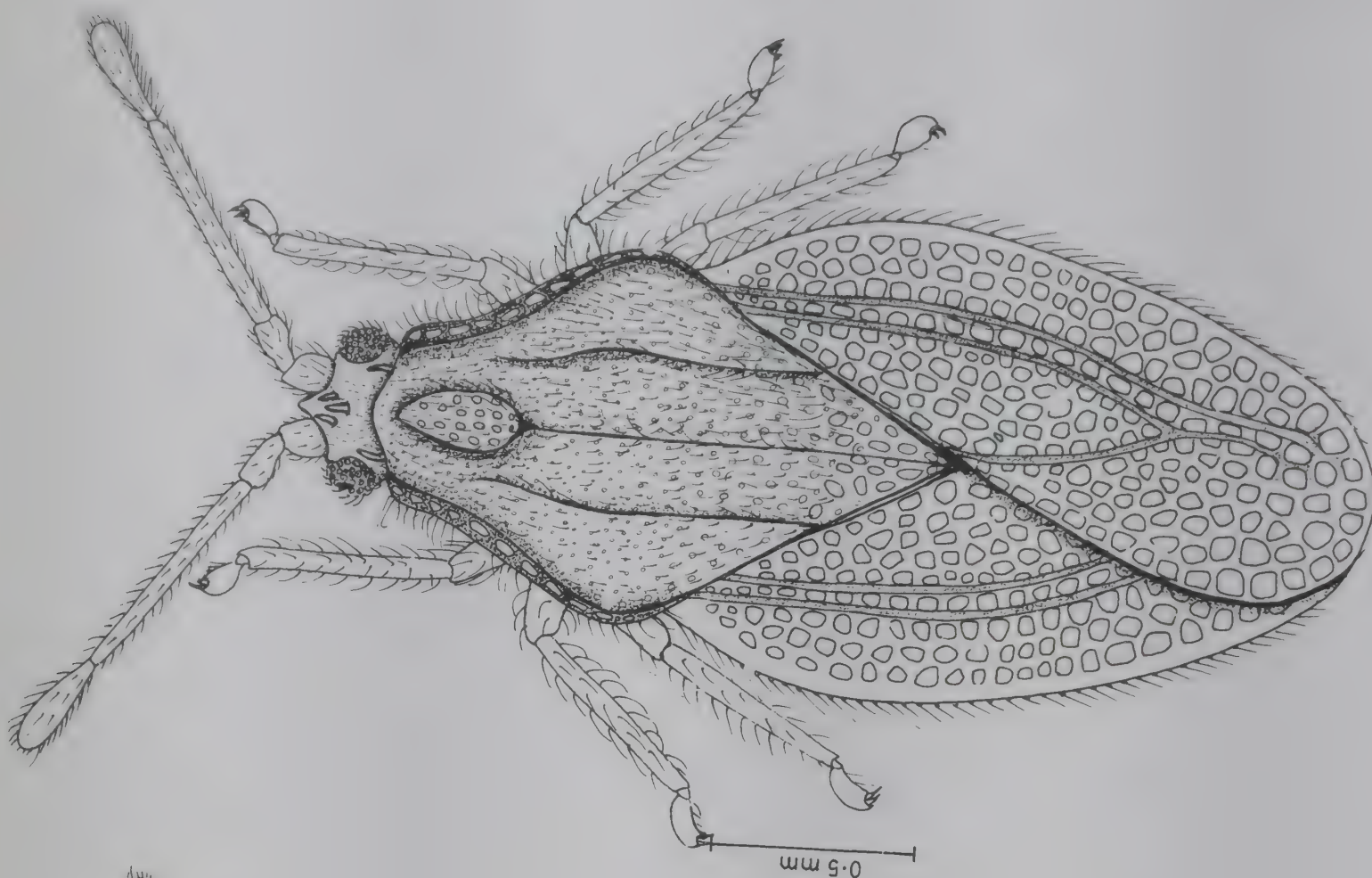


Fig. 7. *Tingis prennae* sp. nov.

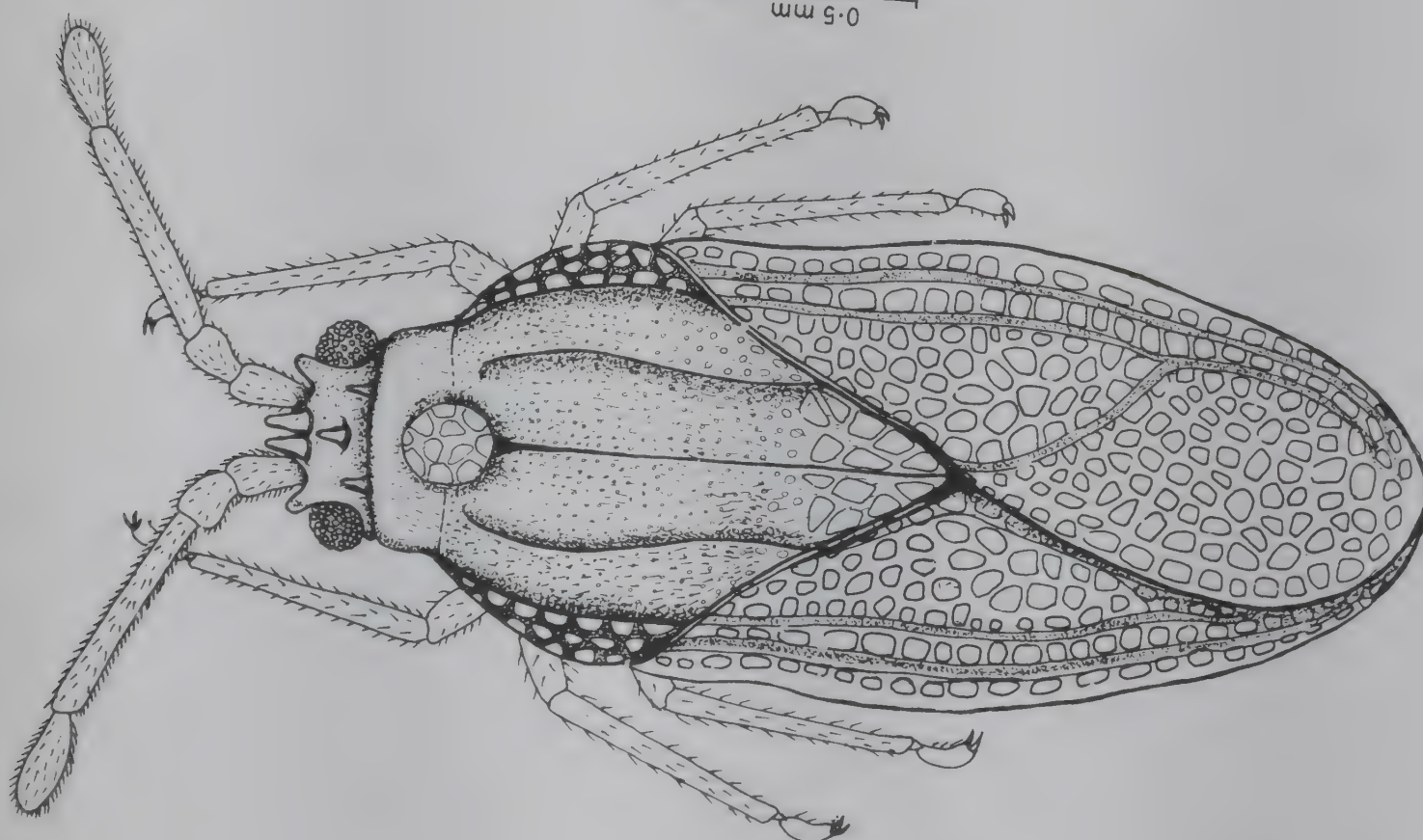


Fig. 4. *Physatocheila asiatica* sp. nov.;



## 6. *Stephanitis macranthai* sp. nov.

Measures 3.21 mm long and 1.15 mm broad, whitish testaceous.

**Head:** Completely concealed by the pronotal hood, exposing the eyes; all five cephalic tubercles porrectly produced in front of the head but concealed by the hood; antennae very long, slender, stramineous; I and II segments sparsely clothed with setose hairs; III and IV segments fringed with long stiff hairs; proportionate lengths of antennomeres: 1:0.3:4:1.8; antenniferous tubercles minute, testaceous; eyes fuscus; rostrum passing middle of mesosternum; sternal furrow broad, laminae nonareolate, closed behind; buccalae triseriately areolate, open, marginally serrated fringed with soft hairs.

**Thorax:** Pronotum slightly convex, finely punctate; tricarinate, median carina biseriately areolate, areolae larger, anteriorly produced into the conspicuous, anteriorly acutely pointed hood, tapering vertically up as a sharp edged carina; lateral carinae rudimentary, sinuous, not reaching anterior region of pronotum and terminating at the base of scutellum; scutellum conical, broadly areolate, medially marked by the median carinae of the pronotum; paranotum greatly expanded; four areolae deep at the middle, serrated, reflexed, marginally spinous elytra passing far beyond abdomen, constricted at the middle; strongly divergent posteriorly, apices wide apart; subcostal area four areolae deep at the middle, confluent posteriorly with the post cubital area; radial area biseriately areolate, confluent with the sutural area; discoidal area very narrow, three areolae deep, cells smaller; sutural area very much reduced with 9-10 large transparent cells; hypocostal lamina broad, uniseriately areolate with serrated margin; clavus with only two cells; outer margin of the elytra finely serrated; fringed with fine small hairs; a few

cells at the apical region of the subcostal area and discoidal region darkly pigmented; legs very long, slender. stramineous, tip of the tibia and transomeres testaceous.

**Notes:** *Stephanitis macranthai* sp. nov. can be easily recognized from *S. charieis* Drake and Mohanasundaram by the strongly reflexed paranotum; presence of setaceous hairs on the pronotum and elytra.

It differs from *S. typica* Distant by having the hood extending far anterior, beyond the pedicel and the paranotum having four rows of areolae. *S. typica* the most common species of this genus is known to be the vector of the virus that causes coconut wilt and is recorded on about 15 species of monocotyledonous plants of economic value (Mathen 1960 & Mathen *et al.* 1972).

**Material examined:** *Holotype:* male; macropterous; 14-4-1981; Yercaud (Salem), Tamilnadu; *Persea macrantha* (Lauraceae). *Paratype:* Four specimens; data same as of holotype.

## 7. *Tingis premnae* sp. nov.

Measures 2.94 mm long and 1.0 mm broad; pale yellow; entire body clothed with pale setose hairs; body beneath fuscus and hairy.

**Head:** Fuscus; all five cephalic tubercles blunt and spinous; antennae moderately elongate, stramineous with numerous, pale, long and stiff hairs; I and II segments subequal; IV segment fuscus, slightly incrassated apically; proportionate lengths of the antennomeres: 1:0.9:4:1.9; antenniferous tubercles short, stout, stramineous; eyes piceous; rostrum light brown; rostral tip testaceous, passing metasternum; sternal lamina testaceous, uniseriately areolate; buccalae punctate, open, fringed with slender hairs.

**Thorax:** Pronotum convex, coarsely



punctate; tricarinate, carinae moderately broad, uniseriately areolate, median carina anteriorly forming a hood and posteriorly merging with the areolations of the scutellum; lateral carinae sinuous, merging with the base of the scutellum posteriorly and terminating anteriorly at the base of the hood; paranotal expansion uniseriately areolate, slightly reflexed on the return and deflects back; margin testaceous, fringed with long soft hairs; hemelytra passing abdomen without constriction, subcostal area, triseriately areolate, merging posteriorly with the radial and sutural areas; radial area uniseriately areolate, confluent with the sutural area; discoidal area five areolae deep in the middle, passing the middle of elytra; sutural area with larger areolae; hypocostal lamina uniseriately areolate, distally merging with the radial vein; clavus biseriately areolate, nonpedicellate spines in the areolae arranged in the form of cart wheel; legs short, femora testaceous; tibia and tarsomeres stramineous, sparsely covered with stiff spines.

**Notes:** *T. premnae* differs from *T. agrana* Drake and Livingstone and *T. buddleiae* Drake

in the nature and development of the paranotal expansion and the hood of the median carination of the pronotum; reduced cephalic tubercles and relatively shorter antennae. This species is recorded only at higher elevations.

**Material examined:** *Holotype:* ♀ female; macropterous; 2-10-1978; Vandalur (Chengalpattu), Tamilnadu; *Premna tomentosa* (Verbenaceae).

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## REVIEWS

1. SELECTED MEDICINAL PLANTS OF INDIA [A monograph of identity, safety and clinical usage]. Compiled by Bhartiya Vidya Bhavan's Swami Prakashananda Ayurveda Research Centre, Bombay. pp. i-xx + 1-387 (22.5 x 15 cm), with 91 coloured plates. Bombay 1992. Published by CHEMEXCIL [Basic Chemicals, Pharmaceuticals and Cosmetics Export Promotion Council, Bombay, India]. Price not mentioned.

This volume gives compilation of information on 111 species of Indian medicinal plants under the following heads:

1. Parts used, 2. Historical aspects, 3. Habitat, 4. Botanical description, 5. Pharmacognacy, 6. Phytochemistry, 7. Ayurvedic properties, 8. Pharmacology, 9. Safety, 10. Clinical usage, 11. Indications, 12. Formulation and dosage and 13. References.

As mentioned earlier, the conventional information given in the book is abstracted from the literature by methodical selection, collection and careful editing. The reader should particularly take note of the caution given on page 378 which warns that without professional expertise one should not try his hand on the medicinal preparations of the drugs given in this book. The technical committee of the CHEMEXCIL is supposed to have been composed of experts on various subjects and scientific disciplines. However it is unfortunate that errors have crept into botanical identities, correct nomenclature and captions of coloured plates given in the book lack precision. Some examples are cited below:

1. *Allium sativum* Linn. "Lasun" - The photograph (no. 7) given in the book is not that of 'Lasun' or garlic but it is of onion or 'Kanda' (*Allium cepa* Linn.).

2. *Boerhaavia diffusa* Linn. "Punarnava". - The plate no. 17 given as that of *B. diffusa* Linn.

is actually a species of *Trianthema*. In fact in certain parts of India some species of *Trianthema* are used as substitute for *Boerhaavia diffusa* Linn. as "Punarnava". The information given in the text is actually a mixture from *Boerhaavia* and *Trianthema*, *Clerodendron infortunatum* (Linn.) Moon. Actually, the name of the species itself suggests that the leaves of the plant are serrate and not entire as seen in the plant photographed.

3. The correct name for *Bombax malabaricum* DC. is *Bombax ceiba* Linn.

4. The correct name for *Butea frondosa* Koenig. ex Roxb. is *Butea monosperma* Lamk.

5. *Clerodendron serratum* (Linn.) Moon, "Bharangi" - The photograph given here is that of *Clerodendron nutans*, not of *Clerodendron serratum*. As the name itself suggests, the leaves of "Bharangi" are serrated and not entire as seen in the photograph.

6. The correct name for *Commiphora mukul* (Hook. ex Stocks) Engler is *Commiphora wightii* (Arn.) Bhandari. The authors citation is a very important part in the botanical nomenclature. In many places in this book the author's names are abbreviated without termination with full stop. For correct nomenclature of this species the name of the original author who described the plant should be placed in parenthesis, followed by the name of the author who placed the species in its proper generic concept.



7. The correct name of "Kulthi" is *Dolichos uniflorus* Lamk. By virtue of typification *Dolichos biflorus* Linn. becomes applicable to some other species and can not be used for "Kulthi".

8. Figure given under *Embelia ribes* Burm.f. is actually *Embelia basaal* (Roem. & Schult.). However, seeds used in Maharashtra as commercial "Vidanga or Vauding" are of *Embelia basaal* (Roem. & Schult.). *Embelia ribes* Burm.f. is more commonly found in South India and used as "Vidanga". It is a climbing plant in contrast to scandent shrubby habit of *Embelia basaal*.

9. Figure of "Neem" given is actually of that of "Bakain" (*Melia azedarach* Linn.), not of *Melia azadirachta* Linn., the correct name of which is *Azadirachta indica* (Linn.) A. Rich.

10. The photograph of "Nisoh" given is actually *Operculina tansaensis* Santapau & Patel, not *O. turpethum* (Linn.) Silva Manso. *O. tansaensis* is a weed of waste-lands in Bombay, whereas *O. turpethum* is only found in Bombay gardens as an ornamental climber and popularly known as "Wood-flower".

11. The correct name for "Bhuiamla" is *Phyllanthus asperulatus* Hutchinson. The name "Niruri" is now applied to an American species due to priority typification (or mistypification).

12. The figure given as that of *Smilax chinensis* Linn. is that of *Smilax zeylanica* Linn. *Smilax china* which has tuberous roots is found

in China and Japan as mentioned in the text. The photograph given here is the Indian species commonly known as "Indian Sarsaparilla".

13. The photograph given under name *Solanum indicum* is correctly identified as *Solanum violaceum* Ortega. The name *Solanum indicum* was applied to this species erroneously and was in use for many years.

14. The correct name of *Solanum xanthocarpum* Shrader & Wendl. is *Solanum virginicum* Linn.

15. Photograph of *Tephrosia purpurea* (Linn.) Pers. is actually *Tephrosia villosa* Pers. which has velvety pods in contrast to glabrous pods of *Tephrosia purpurea*.

16. Photograph shown as *Vanda roxburghii* is that of *Dendrophthoe falcata* (Linn.) Etting. (Syn. *Loranthus longiflorus*).

I fully endorse the opinion of Sir Ramnath Chopra quoted on page xix of the book that any new book on the old theme such as Ayurveda will be always appreciated. However, I wonder whether this costly book prepared with overseas customers in view will be admired for its colourful Indian plants or will be disregarded owing to some of its careless contents which are not scientifically reliable.

M.R. ALMEIDA

2. THE WEALTH OF INDIA - A dictionary of Indian raw materials and industrial products. Raw materials, Vol. 3: Ca - Ci (Revised). pp. i-iii + 1-686 + 1-119 (27.5 x 21.5 cm), with 24 plates and 99 text-figures. New Delhi, 1992. Publications & Information Directorate, CSIR. Price not indicated.

This is the third volume of the revised series of "Wealth of India" dealing with raw materials. Although the introduction does not specify up to which period the information given

in this volume is updated, it appears that the volume contains information up to 1989. This conclusion has been arrived at on the basis of following two entries:



1. Revised handbook of Flora of Ceylon by Fosberg & Dassanaiké, vols. I-IV (1980-1983) have been cited in this volume. Since then three more volumes in that series have been already published (Vols. V-VII, 1985-1991).
2. Flora of Saurashtra by H. Santapau (1962) has been cited in the volume. P.V. Bole and J. Pathak have updated Santapau's first volume and have added two more volumes to that work (vols. II & III, 1989, Published by Botanical Survey of India).

This volume includes some exhaustive articles on crop plants written with original information. Some of the important topics are as follows:

1. Indian Tea : *Camellia* spp. (pp. 96-176, 81 pages).
2. Oranges & Lemons : *Citrus* spp. (pp. 609-679, 71 pages).
3. Red Pepper : *Capsicum* spp. (pp. 218-264, 47 pages).
4. Arhar : *Cajanus* spp.
5. Gram : *Cicer* sp.

The volume as usual is dominated by plant resources of India with very little coverage on Zoological subjects. In this volume information on Civet (pp 679-683) is given. Generally information on insects and insect pests used to be in separate supplement. However, in this volume information on "Cantharidin" is given.

The volume includes 153 plant genera with tremendous information in comparison to the first edition of this series and therefore the bulk of the volume is much fatter.

Some topics are contributed by subject experts and therefore the volume has resulted in new and original information. The annotated use index, a new feature of the revised edition has been continued in this volume like earlier two of this series which will be of tremendous help for

ready reference work. List of periodicals referred for the information is given.

The most important part in this book is perhaps the use index appended at the end of the volume. This index gives cures and causes of various ailments. For example, as cures for cardiac disorders, following plants which are reported in the text are shown in this index in alphabetical order. e.g. :

- Calamintha vulgaris* (p.42)
- Calophyllum inophyllum* (p.72)
- Calotropis gigantea* (p.80)
- Calotropis procera* (p.80)

Similarly plants causing Cardiac disorders have been indexed under causes :

- Calliandra houstoniana* (p.60)
- Catharanthus pusillus* (p.388)
- Cerbera manghas* (p.444)

Updating of nomenclature has been done in few cases. *Senecio quinquefolia* Hook.f. & Thoms. (WI 9 : 276 ) is corrected as *Cacalia quinquefolia* (DC.) Kitamura.

It is for me a dependable volume and important reference guide. However there are also few shortcomings noted in this volume which are given below:

1. There is no consistency in citations of books. In the list of books referred, some books are listed according to alphabetical order of the author's names and some on the titles of the books.
2. Some of the illustrations given in the volume are not reliable. Captions of following two illustrations should be corrected:
  - a. Photograph of *Canna indica* (p.194) is actually of *Canna flaccida* Salisb.
  - b. Figure of *Caesalpinia crista* Linn. is wrong. Its fruit is a smooth pod with a pointed beak.
3. Vernacular names of *Caesulia axillaris* Roxb. - Bhangra (Hindi) and Maka



(Marathi) need verification.

4. In cross references there are some misplaced entries which do not serve any purpose. The following two examples will serve to explain:

- a. Cabbage, Celery, Chinese, Red, Savoy, Thousand headed, White, Wild, Wild Sea --- see *Brassica*.

In alphabetical dictionary like this only the first name (i.e. Cabbage) is relevant. As reader is not going to search name Celery under Cabbage, etc. the remaining entries are misplaced entries under the title name Cabbage here.

- b. Cherries, Amarelle, Bigarreau, Duke, Dwarf, European bird, Gean, Heart, Himalayan bird, Himalayan wild, Japanese flowering laurel, Mahaleb, Marsea.

All the synonyms of Cherries will

serve better at their appropriate alphabetical positions only.

5. In genus *Cajanus* DC. only *C. cajan* is dealt with full details. Other species belonging to this genus are not mentioned. In recent revision of this genus van der Meusen merged all species of *Atylosia* under *Cajanus*. Although it is mentioned on page 18, that some people merge *Atylosia* with *Cajanus*, totalling Indian species of *Cajanus* to 32, it is not stated whether the remaining species under this complex are dealt under *Atylosia* in this work.

In spite of these few shortfalls the volume is extremely well prepared and will be of great utility to research scholars as well as to general public.

M.R. ALMEIDA

3. A FIELD GUIDE TO THE WATERBIRDS OF ASIA. Edited by K. Sonobe and S. Usui, with text by Bharat Bhushan, Graham Fry, Akira Hibi, Taej Mundkur, Dewi M. Prawiradilaga, Koichiro Sonobe, Shunji Usai. Illustrations by Takashi Taniguchi. pp. 224 (18 x 11.5 cm), with 85 colour plates. Tokyo, 1993. Wild Bird Society of Japan. Price not stated.

This slim, elegant and remarkably well illustrated field guide is the result of a collaborative effort between the Wild Bird Society of Japan, the Tokai Foundation of Japan, and the Asian Wetland Bureau. It competently meets its objective of presenting the wildfowl of Asian wetlands to, one hopes, an ever widening circle of enthusiastic bird watchers. The 327 species that have been identified from the marshes, estuaries, mudflats and other wetlands of the Asian Continent have been comprehensively illustrated and described. Comprehensively illustrated in the sense that each species has been graphically described in its

breeding, non-breeding immature plumage and where there is sexual dimorphism it has been illustrated. The illustrations are excellent and except in rare cases, as in that of the Cotton Teal and Turnstone, exceptionally accurate.

The text has been written by a clutch of authors and this reviewer noted with satisfaction that two among these are Indians, one a student of the late Dr. Naik, Baroda and the other a product of Bombay Natural History Society. Some of the authors are more garrulous than the others but all have followed a set pattern which lends to homogeneity. Looking at the "Familiar faces" among the species described, the data



presented is generally accurate, except for a few aberrations such as the recording of the Blacknecked Crane as endemic to the Tibetan Plateau.

It is in the common names that one has cause for complaint. The classification and names adopted are from Howard & Moore's "A complete checklist of the birds of the world" which has a tendency to arbitrarily overlook the claims of traditionally used common names. Fortunately this Field Guide also provides the common names widely used in the regions covered by the book. Still one can hardly appreciate the need to call the Turnstone, the

Ruddy Turnstone when the Turnstone is ruddy only during the breeding season. Similarly calling the Oystercatcher as pied and Palaearctic Oystercatcher when both species are pied makes no sense. The Brownheaded Gull has been named the Indian Blackheaded Gull. However these remarks are only an expression of the reviewers unhappiness with recent trends in the usage of common names and does not in anyway affect the merits of this superb Field Guide.

J.C. DANIEL

4. BIRDS OF INDIA, BANGLADESH, NEPAL, PAKISTAN AND SRI LANKA. By Bikram Grewal, Sunjoy Monga and Gillian Wright. pp. i-xxxvi + 193 (22.5 x 16.5 cm), with many colour plates. Delhi, 1993. Guidebook Company Ltd., Hongkong and Gulmohar Press, New Delhi. Price paperback. Rs.395/-

The concept of a photographic field guide on natural history is a very new one in the South Asian region, and this book deserves to be welcomed in its role as a pioneer. Like all pioneers exploring a new field however, it will, almost by definition have made errors in its attempt to explore uncharted ground, and the authors should be thinking of their future attempts while looking at the reviews of their work.

In India we are at the threshold of an eruption of new field guides on birds, a reflection of the vastly increased general interest for birdwatching in the region over the last decade and a half, which has given rise to an unprecedented 'crop' of extremely knowledgeable and discerning birdwatchers. In this environment, authors and publishers have great responsibility towards their readers. The popular literature on birds (and wildlife in general) that will be available over the next few years will be instrumental in deciding whether the initial

interest in natural history generated by illustrated field guides like Salim Ali's BOOK OF INDIAN BIRDS (whose popularity was heightened by the author's incisive, and humorous descriptions) and S.H. Prater's BOOK OF INDIAN ANIMALS, will be nurtured by future generations.

The book under review has three major divisions; a 20 page introduction that is further divided into several sections, the descriptive text and photographs that form the body of the book, and a 'support' section consisting of several appendices aimed at guiding the novice through his first attempts at trying to identify and learn about birds.

It appears to me that while the various sections included under 'introduction' have been well chosen, some of the information they contain would be more suited to a technical treatise than a field guide ostensibly designed to be of help in field identification. For example, the paragraphs that chronicle the history of ornithological publications in the country restrict



themselves entirely to technical volumes, to the unfortunate exclusion of the several popular and illustrated references (which have however been listed in the bibliography) that users of the present book would find more useful. A few other apprehensions on the introductory sections, including the way biogeographic zones have been discussed (using divisions based on 'compass direction' instead of the accepted vegetation zones), can perhaps be best commented on by making a suggestion. In the best interests of ornithology, authors, publishers and their readers would stand to benefit a great deal if their work was subjected to a process of 'pre-publication review' at the manuscript stage. Our country is fortunate (compared to most South Asian countries) in being blessed with a large number of competent field biologists, whose comments if solicited, would add much to the value of such a book. This suggestion may particularly bear some thinking about given the likelihood that an increasing amount of popular publishing on the subject promises to come from amateur naturalists. The sections on 'Habitat', 'Adaptation' and 'Habits - Feeding and Breeding' make interesting and lively reading, and are marked contrast to the 'history book' approach of earlier sections. A few diagrammatic illustrations and tables may have made possible a more graphic presentation of information in these sections.

The main identification section is a somewhat puzzling mixture of some excellent photographs, together with some glaring mistakes in identification, and a curious editorial policy of leaving over one third of the birds described without a picture. It is not clear for instance, what criteria have been used to select the species represented; many of the species depicted (such as the blackchinned laughing thrush) are relatively uncommon and have distributional ranges that are well out of reach of

the average birdwatcher. The inclusion of only about 340 birds (of which only 242 are illustrated) from a subcontinental total of over 1200 species warrants a mention of why this particular set of species have been selected, given that the title suggests a much more encompassing purview. The lack of good pictures for many species (which is probably why they are not included) is certainly not an embarrassment as any bird photographer will testify, but this is not an excuse for having several pages of text without an illustration in a photographic field guide. Would not coloured plates of these 'missing pictures' have been a good compromise till such time in future editions when photographs became available? Looking at the photographs themselves, given that their main, if not only purpose in this book is to aid in identification, many of these fail in their mission. The picture of a bird on the nest captioned quaker babbler (1109) shows only the head of what is probably an immature bird-it could, just from this illustration, be any one of several other passerine birds. In the same category, as far as a beginning birdwatcher is concerned, is the photograph of a pair of Indian skimmers (484) with a redwattled lapwing in the middle, about which there is no mention in the caption.

The descriptive text, by and large, is a summary of species descriptions that are already in the literature. Indian ornithologists should perhaps consider the fact that many species descriptions have now stood the test of time, and unless there is new material or a new perspective being added, there is no point in shuffling words around. Perhaps the original publishers could be approached for permission to reproduce the relevant parts. Accompanying several of the photographs, are descriptions of two or more congeneric species. The general description (food, voice, range etc.) that follows is often



confusing in such cases as there are often considerable ecological differences between the species described, and no reference is made as to which species' ecology is described. This is compounded by the fact that the illustration very often depicts one of the 'subsidiary' species - this must be corrected in future editions.

The book ends with a useful assemblage of supportive appendices. The glossary and diagram of a bird's anatomy have a handful of small errors. Eclipse plumage and speculum are terms specifically used to describe the plumage of ducks, and not any birds; 'bar-coverts' should read ear-coverts and the position of wing coverts has been wrongly indicated.

There can be no excuse in a book like this for wrong identifications, of which I have been able to detect at least nine (their numbers are listed at the end of the review). Some species are shown in immature plumage, and the sex of the illustrated bird (many species have markedly different plumages in the two sexes) is not mentioned in the captions; though these may appear to be minor criticisms, it is vital that they be corrected if the book is to help in promoting, and not frustrating the widespread interest in birds that is gradually emerging in this country. It could then also serve as a useful supplement in the field even to experienced birdwatchers, who are often faced with perplexing conundrums of identification. A note of apprehension about

the price of the book is in order here. While the cost of printing colour photographs on good quality art paper is undoubtedly very high, one can perhaps question the justification of having the book produced and printed abroad, a factor that probably contributed significantly to the rather steep four hundred rupee price. Publishers of natural history books in this country, and the senior author is one himself, should tread carefully the fine line that is reflected on the price tag, between the advantages of an attractively produced book, and one that a large number of Indians would be able to afford.

My thoughts in ending this somewhat critical review of an important book, are that we have here, a challenge to fuse the best of ornithology and publishing in India, together with related activities like photography; these disciplines are striding purposefully towards goals of excellence comparable with any in the world. We look forward to many more ventures in the same genre, and congratulate the authors on undertaking a bold, and useful venture.

Note: List of species with incorrect identification captions. The numbers refer to those by which the species are arranged. 130, 182, 193, 396, 398 (captioned as 397), 852, 963, 1445, 1109.

SHAHID ALI

5. SPIDERS: AN INTRODUCTION. By K. Vijayalakshmi and Preston Ahimaz. pp. 112 (17 x 11 cm) with numerous black and white and colour illustrations. Madras, 1993. Published by Cre-A: 268 Royapettah High Road, Madras 600 014. Price Rs. 135.

This little handbook introduces the reader to some of the weirdos of Indian natural history, the children of a lesser god, the scorpions, spiders and other arachnids to whom many people may not wish to be introduced. Yet, as the authors rightly point out, this is indeed a

fascinating group of animals. True, many among them, like the whipspiders and sea spiders, look as if they have been dreamed up by the special-effects man of a science fiction movie, the sort of animals one would not like to meet on a dark night. Still, from personal experience, as one



who has handled them, I can say that whipspiders (one species has been named *Phyrnichus phipsoni*, after Phipson, the virtual founder of the Bombay Natural History Society) as also the majority of other arachnids are harmless and should be left alone to pursue their part in the scheme of nature.

This well-planned and produced handbook introduces the various orders of arachnids - the whipscorpions, scorpions, windscorpions, schizomids, whipspiders, harvestmen, microwhip-scorpions, false scorpions, armoured bugs, ticks and mites, sea spiders and horseshoe crabs. Before elaborating on the main theme of the book, the spiders, it is appropriate at this point to digress and draw attention to the fact that the horseshoe crab, which had existed along the eastern coast of India for millions of years, is now endangered by commercial exploitation; a victim of the new open-door national economic policy. It would indeed be tragic if a species, a "living fossil" which has existed for over 300 million years, is to be wiped out in the quest for money.

The book gives brief descriptions of the families of spiders occurring in the country and forty selected species are described and illustrated. It is a pity that the distribution of the

species described is not indicated for it would have enhanced the value of the book. Common names in English have been coined. One wishes that the flower spiders, the thomasids, had been more imaginatively named than "Tommys"! Also, *Heteropoda venatoria* is more familiarly known as the common house spider than as the giant crab spider. The selection of species for description is well done and includes all the spiders commonly seen in the Indian countryside. The reviewer is happy that *Artema atlanta* has been included. One cannot imagine a more fascinating species from its habit of rapidly vibrating up and down on the web when disturbed, and becoming virtually invisible. In my younger days, I had spent many happy hours watching this extraordinary phenomenon. In fact the "Vanishing Spider" would be a more suitable name than "Round Long Legs" as it is called in this book.

This is a book which should find a place on the shelves of all those interested in Indian Natural History. It is also strongly recommended for school and college libraries.

J.C. DANIEL



## MISCELLANEOUS NOTES

### 1. OCCURRENCE OF THE SLENDER LORIS *LORIS TARDIGRADUS* IN SOUTH COASTAL ANDHRA PRADESH, INDIA

On the 21st of September 1993 while studying birds in the Casuarina plantations of Sriharikota Island (13.45° N, 80.20° E) in southern Andhra Pradesh, a small mammal was noticed amongst the dense bushes near the coastal beach area. On closer examination it was identified as a Slender Loris. It had a lean and lanky appearance with long and slender limbs. The dark grey to earthy brown appearance of the animal along with its large reddish brown eyes was diagnostic.

During the present sighting around 0730 hr the animal was quite wary and secretive. It was seen on some of the dense bushes of *Securinega leucopyrus* and *Ziziphus mauritiana* at a height of 1.5 to 2 metres and hence gave me ample opportunity to observe it at close range. The loris was solitary and is perhaps localised near the Casuarina forest patches close to the eastern edges of Sriharikota Island. There are also

reports of the animal being seen from the forest nursery at Keepakam in the western region of the island.

It is interesting to note that this animal has been recorded at Sriharikota for the first time and its presence in south coastal Andhra Pradesh is also noteworthy as there are very few records of the species occurring in this area. The species is known to occur in the Eastern Ghat ranges but there is little information on its distribution in coastal regions. Due to its nocturnal habits it is possible that the animal may have been overlooked all these years in the island.

October 20, 1993

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### 2 TWO CLOSE ENCOUNTERS WITH THE TIGER (*PANTHERA TIGRIS*) IN THE KARIAN SHOLA NATIONAL PARK OF THE ANAIMALAI HILLS, WESTERN TAMIL NADU

On 21 February 1993, I was on a routine fruiting phenology survey of some evergreen forest trees in the Karian Shola National Park, near the settlement of Top Slip in the Coimbatore district of Tamil Nadu. At 0915 hr I was squatting on the buttress root of a large tree in gloomy forest, attending to a nature's call. My attention was caught by the rustling noises made by some animal walking behind me. It was obviously a heavy animal, and therefore, with extreme caution, I slowly turned my head around to investigate the source of the sound. About

thirty feet away and directly behind me, I saw a full grown tiger walking slowly in a direction perpendicular to my line of vision, completely unaware of my presence. There was very little undergrowth and therefore almost nothing was in between the animal and me. Wanting to get away from the scene as unobtrusively as possible, I slowly got up to my feet. The tiger was still unaware of me. I gingerly took one step backwards. Unfortunately, my foot made a noise which caused a very unusual and scary reaction from the tiger. It froze momentarily, spun



around and ran straight towards me. It was not a charge; the animal was simply disoriented and was in panic. I yelled in fright and started running away from the animal, but the animal, having seen me, veered off to the right and disappeared into forest.

The second encounter occurred on 24 March 1993. I was sitting inside a camouflaged ground hide observing the nest of a Great Pied Hornbill about one kilometre behind the village of Erumaiparai near Top Slip. At about 0715 hr, a full grown tiger appeared trotting down the game trail where the hide was situated and froze to a standstill just 15 feet away. I yelled and crashed out of the hide and in the process scared away the animal. This encounter happened about two kilometres from the spot where the first

sighting occurred.

During the two years I spent in the forests of Top Slip there have been at least two other authentic sightings of tiger in the area, one of which by the BNHS Raptor Project staff. I have seen pug marks of tigers here on a number of occasions. The ideal place to look for the pug marks is the moist sandy soil flanking the jungle streams.

I thank Mr. J.C. Daniel for his comments on the sightings and for prompting me to write this note.

September 25, 1993

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### 3. ALBINO COMMON MONGOOSE (*HERPESTES EDWARDSI* GEOFFROY) 'SIGHTED NEAR UDAIPUR

(With a photograph)

Kallarwas is a village situated about 15 km from Udaipur city in Rajasthan. On 13th March 1993 an albino common mongoose (*Herpestes edwardsi*) was sighted by us near the fence of an agricultural field. It soon disappeared. We were excited at the sighting of this attractive snow white mongoose. For the next three days we combed the area to take photographs of this beautiful little animal. On the 3rd day at about 1715 hr we sighted it emerging from a hole in a nullah. After being in the nullah bed for a few moments, it again disappeared in a dense patch of undergrowth. We took a few photographs with a 200 mm tele-lens.

Again in the month of April we had a glimpse of this mongoose. This time, three young ones were trailing behind it, which confirmed that the albino was a female. All the three young were of normal colour.



Photo. 1. Albino *Herpestes edwardsi*.

It roams in about a square kilometre area



consisting of agricultural fields, scrub land and a nullah. Enquiries from villagers residing nearby revealed that they have seen other litters of this female in the last two years, but found all the offsprings were of normal colour.

After consulting the BOOK OF INDIAN ANIMALS by S.H. Prater (Third impression 1990) we concluded that albinism in common mongoose has not been reported so far and ours

is the first sighting of an albino common mongoose.

July 23, 1993

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#### 4. UNUSUAL FEEDING BEHAVIOUR OF THE GREY MUSK SHREW *SUNCUS MURINUS* LINNAEUS

On 13 April 1993, around 2 a.m. in the night I was awakened by loud squeakings of the Grey Musk Shrew *Suncus murinus* at Fulay village, Kutch, Gujarat. In the torch light I saw a shrew holding a toad in its snout and smashing the victim against the ground. The toad was about 4 cm (snout to vent length). I tried to photograph the shrew with its unusual food, but soon the shrew disappeared with its prey behind the bottles lying nearby. On searching I found a half eaten toad and other dried up skeletons of the toads in a box. The box with some household articles was the favourite haunt of the shrew.

Locally the Grey Musk Shrew is known as Ghush in Kutch. Apart from toad I have observed the Grey Musk Shrew feeding on dead

fish near a fishermen's camp at Chhari-Dhand wetland, in Kutch. The villagers from Fulay reported that shrews carry away chapatis (wheat flour cakes) from houses. They further added that the young ones of the Ghush walk in a line holding each other by tail, as if a train of shrews is progressing.

The Grey Musk Shrew does feed occasionally to supplement their diet with food other than insects.

October 7, 1993

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#### 5. BURROW PATTERN OF INDIAN GERBIL *TATERA INDICA INDICA* HARDWICKE

(With two text-figures)

##### INTRODUCTION

Most of species of rats burrow and construct their burrows for shelter in soil. Their tunnelling, and excavation in fixed soil threatens

conservation work. Some times, Kachcha houses and dams are destroyed during rains due to their burrows. The Indian Desert Gerbil moves about 17,000 kg soil per hectare which is blown away by strong winds increasing the area of sandy



wastes and barren land (Prakash 1976).

#### MATERIAL AND METHODS

The burrows of *T. indica* were studied by digging them out in alternate months during the year 1988-89. The observations on morphometrics of burrows in respect of their openings, length, width, depth and number of external structures like brood chambers, storage/food chamber, bolt run, escape hole (emergency openings), number of animals and quantity of hoarded materials were taken.

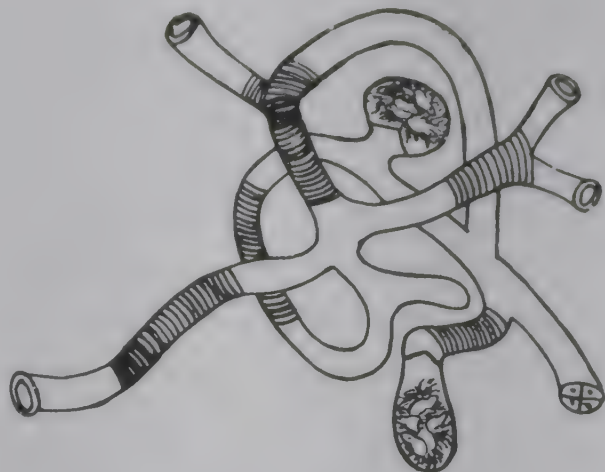
Apparently, the burrow openings of *T. indica* were clear with 3-5 similar openings over the burrow surface area. Only live burrows were dug out for various studies which were ascertained by closing them in the evening and on the next day, the burrows which were found freshly opened were considered as occupied by *T. indica* (Fig. 1).

#### RESULTS AND DISCUSSIONS

The details of burrow pattern studied



Fig. 1. Burrow of *Tatera indica indica* Hardwicke.



INDEX:	
	SURFACE OPENING
	BOLT RUN
	BROOD CHAMBER
	EMERGENCY OPENING

Fig. 2. Burrow pattern of *Tatera indica indica* Hardwicke

indicate (Table 1) that overall average length, breadth, depth and diameter of burrow openings were 210.5, 179.5, 107.2 and 5.3 centimetres respectively, while the mean number of brood chambers, surface openings, bolt runs, escape holes (emergency openings) and rats per burrow were recorded to be 1.05, 4.1, 4.9, 1.04 and 3.8, respectively. The average burrow length, breadth, depth and diameter ranged 170.5-261.1, 118.9-205.7, 99.7-118.3 and 4.9-6.1 centimetres, respectively. Similarly, the brood chambers, surface openings, bolt runs, emergency openings and number of rats per burrow ranged between 1.0-1.2, 3.7-4.8, 4.7-5.5, 1.0-1.2 and 1.3-6.0, respectively.

It was interesting to note that in the burrow of *T. indica* food chamber was absent and



TABLE 1  
BURROW PATTERN OF INDIAN GERBIL *TATERA INDICA*



consequently held no hoarded food materials except a few spikelets of wheat lying in the burrow channels. The male and female adult gerbils occupied the same burrow along with young ones. The species lived in congregation. The burrow structure was also sketched (Fig. 2).

The external opening of the burrow of *T. indica* clearly opened along with 3-4 similar openings over the burrow surface area. *T. indica* forms bolt runs with loose soil at 15-22.5 cm depth from the surface, each opening 10-15 centimetres. Emergency openings at the distant end from the main openings seen in the burrow of *T. indica* were similar to that of *B. bengalensis*. *T. indica* constructed its burrows in a definite pattern and was not as complicated as that formed by *B. bengalensis*.

The maximum depth of the burrow of this species was 118.3 cm in June and the minimum was 99.7 cm in December.

The present findings on the formation and definite pattern of the burrow of *T. indica*, that is devoid of food chambers and showing anti hoarding behaviour are in conformity with the findings of George *et al.* (1982) who also found the burrow of this species in Kerala following definite pattern, being either short, simple or elongated showing minimum of three openings

without any evidence of grain hoarding.

Prakash (1981) had observed that the burrows of *M. hurrianae* were generally extensive and more complicated than those of the two nocturnal gerbils, namely *T. indica* and *G. gleadowi* inhabiting Rajasthan desert. His findings are also in agreement with the present observations.

Similarly the burrow pattern of *R. meltada* as studied by Chopra and Sood (1980) and Rana and Prakash (1980) who also recorded various measurements of burrows are similar to the present studies.

#### ACKNOWLEDGEMENTS

We are grateful to the Vice-chancellor, C.S. Azad University of Agriculture and Technology, Kanpur for providing facilities and encouragement and to the Director, Zoological Survey of India, Calcutta for assistance in identification.

November 18, 1993

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6. THE INDIAN PANGOLIN *MANIS CRASSICAUDATA* GRAY NEAR DELHI

The survival of Indian Pangolin is not uncertain or questionable, it is very much present in the forests of Delhi, and I myself had an encounter with this species, at our farm house in Chatterpur Mehrauli, six years back.

One moonlit summer night around 11 p.m. my grandparents who stay at the other corner of our farm which is also closest to an abandoned scrub land of Southern ridge, heard some rustling noise, which gradually grew violent. My grandfather thought that a robber must have entered our tube well room and was trying to cut of some heavy electricity wires coming from the main transformer and went to see for himself. As he was crossing through a patch of subabul and acacia plantation, he saw a strange creature digging earth from a termite mound with its forelimbs.

My grandfather understanding the whole matter at once called for me and I went running with an axe and electric torch. When we threw light on it and touched it with a long stick it curled itself into a ball and all our efforts to unroll it failed, even blows of an axe were not enough to change its position, and at one time my father thought of firing upon it with no. 2 load of point 12 bore shotgun but I refrained

him from doing so and gave the idea of capturing it and presenting it to Delhi zoo. So we decided to cage the animal till morning and then put it into a bag, load it into our jeep and take it away to zoo in the morning. We placed a half empty barrel to make it heavy so that the Pangolin could not lift it, but to our great astonishment after few minutes it was able to move the heavy barrel and try to escape. As we were still present near it we again quickly captured it and loaded some heavier stones on it and we were more convinced that this was sufficient to put the animal down and went back to bed. But at midnight the caged Pangolin again escaped from captivity by digging and lifting the heavy load. In the morning we saw the tilted barrel and some dug earth and its tracks leading to a nearby rocky hill from where onward we lost its tracks. So due to lack of much knowledge and a proper cage we were deprived of a fine specimen of Pangolin which is living very much within Delhi limits.

November 10, 1993

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7. GARGANEY *ANAS QUERQUEDULA* LINN. RECOVERED ABOVE 3950 M IN THE WESTERN HIMALAYA

I spent 20th to 22nd June above tree line photographing flowers. At approximately 4100 m on the Panduopa Ridge directly across the Beas Valley from Manali and overlooking the Rohtang Pass (3950 m), my dog which was sniffing around a large rock as I was photographing a fine cluster of *Primula nivalis* started yelping excitedly. Going up to

investigate, I found a well preserved female Garganey under an overhang.

One may speculate that the bird exhausted, must have taken shelter from strong storm conditions on the main axis of the Pir Panjal which stands across the head of the Beas Valley, and is a major physical barrier.



It may be mentioned that this is the third duck I have found in the last two decades. The first two were a female Common Teal *Anas crecca* at the head of the Solang Valley a little to the west of the Rohtang, a male Tufted Duck *Aythya fuligula* on the mountain slope rising above the pass to the west. All three species are

found on Tibetan lakes during summer.

July 11, 1992

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## 8. A BREEDING RECORD OF THE CRESTED HONEY BUZZARD *PERNIS PTILORHYNCHUS RUFICOLLIS* LESSON

The Crested Honey Buzzard occurs patchily in Kutch (Gujarat). It is usually seen in large gardens and irrigated 'wadis' with large trees. So far there was no record of its breeding in Kutch, though it was presumed to be resident (THE BIRDS OF KUTCH, Salim Ali 1945). M.K. Himmatsinhji (pers. comm.) a senior ornithologist of this area feels this bird could also be moving locally within the district or into the adjacent districts of Gujarat. He also had not come across this bird breeding in Kutch.

I was informed by Mr. A.O. Langha, a forest guard in Moti Virani, Nakhatrana Tehsil (Taluka), that there was a nest of Honey Buzzard in a 'wadi' (an irrigated farm) near the village. On July 9, 1992 we saw a nest of the Crested Honey Buzzard on a *Ficus* tree. The nest was placed at about 16 m above the ground and its size was about that of a House Crows nest. One fledgling was seen in the nest while the second one had dropped to the ground and was seen moving amongst the buffaloes tied in the shade of the tree. As is usual with this species, the colours of the young differed from the adults. Even amongst the two young ones, the one in the nest appeared to be lighter coloured than the one that had dropped to the ground. This fledgling was of the darker phase with cream, or buffish underparts with the breast having dark streaks. The most prominent feature was an erect

developing crest on the fore-crown. The parent birds also had crests. M.K. Himmatsinhji visited Moti Virani along with Mr. Shantilal Varu on July 16, and they confirmed our estimate of the age of the fledglings to be about 20 days. Soon after this there was a very heavy rainfall in the area; and in the gale that followed the tree with the nest fell down. The fledgling on the ground died and I presume the one remaining in the nest which must have been about a month old by then may have left the nest, because when we visited the 'wadi' there was no trace of either the young or the adult birds. It was my intention to examine the contents of the empty nest, but the owners of the farm had by then cut up the various branches of the tree to remove it leaving no trace of the old nest. However we examined the surroundings of the tree while it was still standing and we found pieces of honey-combs near the trunk of the tree, and directly from under the nest.

This appears to be the first breeding record of the Crested Honey Buzzard in Kutch.

October 12, 1992

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## 9. AN UNUSUAL ROOSTING SITE OF THE MARSH HARRIER *CIRCUS AERUGINOSUS* (LINN.)

Marsh harriers are known to roost on ground. However, on 31 March 1992 at 6.45 p.m. we saw a number of marsh harriers c. 67 perched on 22 KW high tension wires and tower tops, near Bhangur Nagar, Goregaon (W). The area near the creek is Marshy. We continued our observation every evening between 6.45 p.m. to 7.15 p.m. during April. The birds used to return around 7.00 p.m. and all were settled by 7.15 p.m. When disturbed by children playing around they moved on to the H.T. Towers. The maximum number seen was c. 150 birds on 7 April.

Apparently, this was a migratory flock on its return journey. Since the last many years VKP used to watch these birds at dusk flying in north-west to south-west direction for roosting.

October 25, 1992

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## 10. OBSERVATIONS ON THE COURTSHIP, NESTING AND HUNTING BEHAVIOUR OF THE CRESTED SERPENT EAGLE

**Display:** Previously unrecorded display of the Crested Serpent Eagle *Spilornis cheela* was frequently observed at Corbett National Park, situated in the lower Himalayan foothills or Sivaliks within the Bhabar tract of Northern U.P. Commencing around end-February mainly during the pairing off period when courtship began, such behaviour was observed mainly during March/April with diminishing frequency till egg-laying in late May. It involved an individual or pair flying slowly at varying height, often low above the tree canopy with wings held high in a sharp "V", (this courtship display flight) as described previously (Naoroji 1985). A slow downward glide would then be executed, with the wings drooping (slightly below the body plane) and wing-tips curved downwards, interspersed with frequent "shivering" of the wings every few seconds while maintaining the gliding speed. While one

bird "shivered", the other would continue to soar above it or alternately "shiver". It must be emphasized that the "wing shivering" action was executed when the wings were in drooping position, and performed independent of, or as an extension of the "V" display flight, invariably accompanied by persistent vocalisation which draws attention to the display. A new call "cheeu, cheeu ...." not previously recorded resembling a Grey Hornbill's *Tockus birostris* but shriller accompanied some of the displays. The Crested Goshawk *Accipiter trivirgatus* similarly flutters the wings during display (Robertson 1990, Sikora 1990). Though its significance cannot be fully gauged it appears that through "shivering" the birds additionally draw attention to themselves when competing for mates or maintaining the pair bond. Performed singly (sex undetermined) to probably attract a mate's attention, two adults "shivering"



simultaneously could be vying for the attention of a single female perched hidden in foliage or soaring out of sight. Quite likely, pairs too "shiver" together as part of the normal display which probably assists in cementing the pair bond. The display may also fulfill a secondary function in advertising as established territory. Surprisingly the "shivering" was not observed at Rajpipla in the southern race. Therefore the extent and significance of the "shivering" in the nuptial display of both races needs further investigation, and whether performed by both sexes or mainly by the males.

**Nesting:** Serpent Eagles normally build their own nest (Ali and Ripley 1978, Baker 1932, Naoroji 1984, 1985). At Corbett National Park, a pair nested in an old White-backed Vulture's *Gyps bengalensis* nest from which a fledged juvenile vulture had recently flown. The adult pair unsuccessfully incubated for at least 40 days, from late March when the nest was located to mid-May. The nest was 9 m high in a khabar tree *Ficus rumphii* and continuously lined with green leaves throughout incubation. The nest-tree was situated within forest at the edge of the chaur or grassland bordering the Ramganga river. In the subsequent year, two pairs of Serpent Eagles nested in disused nests of Changeable and Mountain Hawk Eagles. The nests have been described (Daniel *et al.* 1991). Alternative nesting trees were available, so the choice of other raptor's nests indicates that the species does not always build its own nest when disused nests of other species are readily available. Whatever the reasons, these are the first records of the species not building its own nest and appears to be a deviation from the usual known behaviour.

**Hunting:** The Crested Serpent Eagle supplements its principal diet of snakes with

small mammals, injured birds, frogs, and lizards (Ali and Ripley 1978, Naoroji 1984, 1985).

Bhagatsingh, a regular visitor to the park (pers. comm.) made the following observation confirmed by photographs at Corbett. He witnessed a Serpent Eagle attempting to carry off a Flying Squirrel *Hylopetes fimbriatus* (body length 25-30 cm, Prater 1980, weight 700 gm to 1 kg, Ellerman 1961), for a short distance before dropping it, unable to rise more than 3 m with the quarry. After two more unsuccessful attempts to carry it away, the eagle finally left the incapacitated, yet alive squirrel on the ground. The photograph clearly shows talon marks on its back where it had been seized. This is the first confirmed record of the Crested Serpent Eagle attempting to prey upon a large-sized mammal, more than the average weight threshold of prey usually taken by the species. Usually, if undisturbed, a mammal of this size would be consumed on the ground.

Along the Ramganga river passing through Corbett, a Serpent Eagle was occasionally seen fishing at a point called Gethia Rao. Perched on low rocks (15-30 cm high), overlooking shallow pools only a few inches deep where Mahseer *Tor tor* fingerlings had amassed, the single bird repeatedly plunged into the thick shoals of fingerlings. The eagles fished in much the same way the species hunts water snakes, usually from a low branch overlooking shallow streams and marshes. Two pairs of Lesser Greyheaded Fishing Eagles *Ichthyophaga lana* hunted daily on the same stretch of the river. The fishing strategy of the lesser Greyheaded Fishing Eagle from a tree perch or low rocks, and the hunting method of the Serpent Eagle are similar. This particular individual was able to take advantage of an abundant, easily available food source without much altering its water snake hunting



method. This ecological adaptation may have possibly been stimulated through observation of the Lesser Greyheaded Fishing Eagles. As this strategy was adopted by only one individual and observed only at Gethia Rao where both species were present, it was most likely a learned behaviour.

This is however the first record of Crested Serpent Eagle taking fish. I have observed a Serpent Eagle single out and capture an adult healthy and uninjured Jungle Babbler *Turdiodes striatus* from among a flock at the edge of a road. Serpent Eagles are opportunists and versatile hunters, taking a wider range of prey than is recorded.

## ACKNOWLEDGEMENTS

I am grateful to Mr. R.S. Bhadauria (IFS), CCF (wildlife), U.P. for permission to work in Corbett National Park and to Mr. A.S. Negi, Field Director, Corbett National Park who provided all possible help and co-operation. Special thanks to David Ferguson, Alice Pandya, Mr. J.C. Daniel and Prof. R.M. Naik for back-up support and assistance, Asad Rahmani and Taej Mundkur made detailed comments and Manoj Muni unearthed elusive references.

October 30, 1992

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# 11. NESTING OF LAGGER FALCON (*FALCO BIARMICUS JUGGER* J.E. GRAY) IN THIRUVERUMBUR, TIRUCHY DISTRICT, TAMILNADU

On 13 January 1992 we spotted a Lager Falcon (*Falco biarmicus jugger*) nest at about 37.7 m high tower near Thiruverumbur. The nest had three creamy white eggs measuring 53 x 40 mm. One egg hatched on 15 February 1992 and the remaining eggs vanished from the nest on

subsequent days.

On 2 April 1992 midday, i.e. the 47th day from hatching the nestling took its first flight.

Their main food consists of rats, owl, swifts, and lapwings (both red wattled & yellow



wattled from the nearby lakes) as recorded by us.

In the 'THE BOOK OF INDIAN BIRDS' it is stated that the Lagger Falcon is rare in extreme south India. And from the book 'BIRDS OF KERALA' there are only two records of its occurrence in the entire old Madras Presidency (i.e. including eastern Andhra Pradesh) (vide

Whistler JBNHS 38: 419).

July 9, 1992

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## 12. BREEDING RECORDS OF COOT (*FULICA ATRA* LINN.) IN SOUTH TAMIL NADU, INDIA

The coot *Fulica atra* is a resident as well as a common and abundant winter visitor to India especially on larger jheels in northern India (Ali and Ripley 1983 HANDBOOK compact edition). Though the breeding season of this species in south India is reported as November and December by Ali and Ripley (loc. cit.), the record from Tamil Nadu is scanty or none.

The survey conducted on the wetlands of south Tamil Nadu during February 1991 under the Bird Migration Project had recorded the breeding of coot in two heronries at Chithirankudi (c. 9°20' N; 78°30' E) of Ramanathapuram District and Udhayamarthandapuram (c. 10°35' N; 79°30' E) of Nagai Quaid-e-Milleth District. The former is a well known heronry since 1972 where 18 species of egrets, herons, and pelicans breed and

the latter is a recently established heronry where mostly openbilled stork *Anastomus oscitans* and night heron *Nycticorax nycticorax* breed. At Chithirankudi three adult coots were observed feeding chicks, mostly with small fish and molluscs. As the young ones could not balance to fly, it is assumed that they fledged recently. Similar observations were made at Udhayamarthandapuram also. Coot's nest had been earlier sighted by the Forest Department watchers posted there. As the water sources of these two sites dry up during summer, the status of the coot at the two sites can be termed as breeding migrants.

October 15, 1992

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## 13. THE RINGED PLOVER (*CHARADRIUS HIATICULA TUNDRAE* LOWE) IN SRI LANKA AND PENINSULAR INDIA

Based on evidence presented in this paper it is likely that the Ringed Plover is very generally overlooked, and that it may indeed not be as rare

a winter migrant as hitherto thought. Like in the case of several other rare waders, the numbers reported from the Indian Sub-continent and Sri



Lanka show a steady increase, and the Ringed Plover might now be regarded as a regular winter migrant in small numbers, rather than a straggler.

The race *tundrae* breeds along an extended arc from northern Scandinavia to eastern Siberia; most birds winter in western Africa, but some appear in China. Vagrants are spread from Pakistan through northern India, to as far as Australia and New Zealand.

Until recently the Ringed Plover was regarded as a straggler to the Indian Sub-continent and Sri Lanka. Ripley (1982) in his SYNOPSIS refers to "only a half dozen records for the Indian Sub-continent", and the HANDBOOK (1969) characterises it as "a straggler or very rare winter visitor, with only 3 known specimens and 2 sight records". The first reliable record of a single Ringed Plover in Sri Lanka was a sighting by G.M. Henry in the Jaffna Peninsula in 1944. For many years this remained the only observation, but from 1973 onwards single birds were noted from time to time and reported in the Ceylon Bird Club Notes. Although all these are sight records, there can be no doubt about the correctness of the identifications, as they were made by reliable, experienced bird watchers, and because the Ringed Plover is readily noticed mainly on account of its bright orange-yellow legs; it is not difficult to identify and separate from the Little Ringed Plover (*Charadrius dubius*) in mid-winter. In the last decade one or several single birds were noticed almost every year, usually in connection with the Annual Asian Waterfowl Census in mid-January. The totality of known records in Sri Lanka (Phillips and CBCN) may be summarised as follows:

These records show a very gradual increase in numbers and frequency. Obviously not all the birds visiting Sri Lanka were seen and recorded.

In January 1991 a considerably greater number was noted for the first time. During the

1944	..	1
1973	..	1
1983	..	4
1985	..	7
1986	..	4
1987	..	4
1988	..	1
1990	..	3
1991	..	19
1992	..	8
		(To February)

waterfowl census I observed 11 Ringed Plovers in a muddy grass-flat south of Kalpitiya between the main road and the Puttalam Lagoon. The 11 birds freely mingled with a much greater number of Little Ringed Plovers, amongst whom there were many juveniles, recognised by their hooded appearance. As the area was very muddy at the time, I was restricted in my movements and feel that there were more Ringed Plovers than I could see. Another counter, Rex De Silva, subsequently reported 8 Ringed Plovers from a mud-flat between Puttalam Lagoon and Mundel Lake in the same general area, which brings the total for the year to 19.

There has been a similar though less regular development in the Indian Sub-continent. The BNHS Bird Migration Project has so far ringed a total of 5 individuals, namely 3 at Bhratpur in 1982, 1 at Karera in Madhya Pradesh in 1986, and 1 at Mandapam in 1988; a specimen in the Society's collection was taken at Mandapam in March 1970 (J.C. Daniel pers. comm.). In February 1988 a Ringed Plover was trapped at Dhanushkodi, and on February 22, 1990 two



were caught at Muthupet, according to S. Balachandran. V. Santharam (1989) states that he has recorded the Ringed Plover on no less than 53 occasions in the Adiyar river estuary at Madras in the 8 years between 1979 and 1986; all his sightings were between January and April, and the number obviously includes multiple sightings of the same birds. The habitat is described as sandbars and mud-flats in an estuary, which is quite different from Sri Lankan habitats where Ringed Plover is usually seen, namely grass, mud and sand-flats along lagoons or villus. Santharam suggests that Ringed Plover is not as uncommon in India as noted by Ali and Ripley, whereas Balachandran their status assessment.

Apart from the Madras report these are meagre pickings for the entire Sub-continent, and it must be noted that the species has not been recorded in the first 4 Asian Waterfowl Censuses (1987-1990), in which considerable numbers of Indian Ornithologists and bird watchers have participated and which have covered practically all the important Indian Wetlands frequented by migrating waders. However, the early data from the Asian Waterfowl Census are not very reliable when it comes to details like this. Up to 1991 the Ringed Plover was not shown in the annual report statistics and is still not included in the newest

census form. The fifth (1991) Report records 162 Ringed Plovers from Gujarat, but all other Indian states give nil reports on this species. However, N. Lindsey, a visitor from U.K., reports having seen on the 20th of January 1991, at about the time of the Waterfowl Census, a flock of 70 Ringed Plovers at Pulicut Lake in Andhra Pradesh (OBC Bulletin No.13, Recent Reports, p. 50). This appears to be the first report of the Ringed Plover in any numbers from the southern half of the Sub-continent.

Perhaps further intensive censusing during the annual Asian mid-winter waterfowl count will produce more evidence of the presence and origins of the species in the Sub-continent. It is hoped that the International Waterfowl and Wetlands Research Bureau will refine its censusing and reporting systems, so that reliable information on individual species could be obtained.

#### ACKNOWLEDGEMENTS

I am indebted to Mr. J.C. Daniel for literature references and information not available in published form.

August 18, 1992 THILO W. HOFFMANN

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#### 14. SOME INTERESTING BIRD RECORDS FROM KALIVELI LAKE NEAR PONDICHERRY

Kaliveli Lake (11° 56' N; 79° 50' E) is one of the important wetlands in south India especially for migratory waterfowl, waders, terns and gulls. The hydrology of the lake is complex as it contains mainly freshwater during the rainy season (October to January), and gradually dries up and becomes brackish during March and April. Hence, the lake acts as a wintering site for the freshwater wader species such as ruff and reeve *Philomachus pugnax*, eastern golden plover *Pluvialis dominica*, spotted sandpiper *Tringa glareola*, marsh sandpiper *Tringa stagnatilis* and migratory waterfowl such as ducks, pochards till January.

During March and April a large number of brackish water and coastal habitat preferring waders such as curlew sandpiper *Calidris ferruginea*, lesser sand plover *Charadrius mongolus*, little stint *Calidris minuta*, greenshank *Tringa nebularia* and terns such as whiskered tern *Chlidonias hybrida*, and gullbilled tern *Gelochelidon nilotica* use this lake as a staging site for their spring passage. The bird migration study conducted during different periods of the migratory season has resulted in some interesting bird records from this lake.

##### Caspian plover *Charadrius asiaticus*

One Caspian plover in partial breeding plumage was sighted along with a small flock of lesser sand plover on 14 March 1990 and was observed there till 17 March 1990. It is also interesting to note that the Caspian plover was recorded further south in Point Calimere one month prior to this (Krys *et al.* in press). As I observed this species in both the places, I could make out that the bird sighted at Kaliveli was

almost with the same amount of breeding plumage. This bird was not shy and I could observe it at close quarters (c. 30 m) through a telescope and also photograph it. It fed on a dry grassy patch in a typical plover fashion. When I followed the bird it was also slowly moving along with few lesser sand plovers. When it was continuously disturbed it flew back to the area where it was first seen.

Earlier to these two sightings, this species was sighted once near Ratnagiri (17° 8' N; 73° 19' E) in 1880.

##### Indian courser *Cursorius coromandelicus*

Although Ali and Ripley (1983), stated that the Indian courser is a common resident and is patchily distributed everywhere, it is suspected to be a local migrant. Two pairs of Indian courser were sighted on dry grassy patches along the lake during the third week of March and also the first week September 1991. Though this species was listed in the preliminary checklist of the birds of Kaliveli lake (Perennou 1987), there is no further authentic record of its occurrence elsewhere in Tamil Nadu. This is the first record of the species during the last 12 years of bird migration studies in Tamil Nadu.

##### Black tern *Chlidonias niger*

The Black tern was first recorded in India near Delhi by Alexander (1950). Later its occurrence was confirmed by a recovery of Russian ringed Black tern at Point Calimere in 1970 (Abdulali and Ambedkar 1983). Its further occurrence at Point Calimere was reported by Natarajan and Balasubramanian (1990) and at



Pulicat Lake by Mohapatra and Rao (1993) by ringing. This species is now regularly reported from Point Calimere as 25 birds have been ringed between 1990 and 1992 under the Bird Migration Project. At Kaliveli, out of 51 terns ringed during March 1991, seven were black terns. This is further evidence of its occurrence

not only at Kaliveli, but also along the southeast coast of India.

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### 15. RECENT SIGHTING OF BLACKBELLIED TERN *STERNA ACUTICAUDA* J.E. GRAY IN KERALA

On 2nd and 4th October 1992 at 1430 hr while watching the waterfowls at 'Kolom Kayal' swamp (marsh surrounded by paddyfields), Kerala, a Blackbellied Tern *Sterna acuticauda* (Temminck), was sighted. The wetland is situated by bank of the river Bharathapuzha, approximately 2 km from Trithala, Palakkad district.

items. Also it produced some rough call notes, like "quir-quir-quir....".etc.

In Kerala, the tern was observed for the first time on the bank of Gayathry river, Palakkad district (Prof. K.K. Neelakantan, pers. comm. 1944) and A.J. Gaston recorded a Blackbellied Tern in Cheruthuruthy, Thrissur district (J.K.N.H.S. Vol. 2. 1979).

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The bird was in breeding plumage, so that I could easily distinguish it from other similar terns, such as River Tern *Sterna aurantia* T.E. Gray. The tern was flying over the paddyfields and its red legs were seen only while they dangled when plunging into water for food



## 16. NILGIRI WOOD PIGEON *COLUMBA ELPHINSTONII* (SYKES) AT NANDI HILLS NEAR BANGALORE

Nandi Hill (13° 22' N; 77° 41' E) in addition to being a place of considerable historical importance, is a popular holiday resort (Anon. 1968), located about 60 km north of Bangalore. This hill (also referred to as Nandi Durg) located at the beginning of a range of hills, falls within the 28.37 sq. km Nandi State Forest comprising of three main hills (over 1400 m above msl) with about seven peaks in all. Of these Nandi Hill is the Highest (1435 m above msl) formed partly out of a giant tor that rises vertically from the ground.

Though Nandi Hills has a general pattern of scrub and deciduous type of vegetation, altitudinal variations in the floristic composition can be seen owing to the influence of several ecological factors (Boraiah and Fathima 1970). There is an extensive plateau on the top sloping to the west and harbours a crater like depression to the northwest. Part of this depression supports evergreen vegetation with a dense shrub layer dominated by *Coffea* spp. In addition to a few lianas, the trunks and branches of the vegetation within this evergreen patch are draped with *Spagnum* moss.

While one of us (SS) was watching birds in the evergreen patch on the evening of 17 October 1987, two Nilgiri Wood Pigeons *Columba elphinstonii* (Sykes) were observed flying into a dense canopied tree for roosting. Next morning while the evergreen patch was being surveyed a total of five individuals of the species were sighted. Two of these were seen basking in the early morning sunlight while perched on *Casuarina equisetifolia* trees, on the eastern ridge, affording a clear view, and their identity could be further confirmed.

When the area was visited again on 10 August 1990 one individual of the species was

sighted. On subsequent visits on 18 October 1991, 10 November 1991, and 19 November 1992 two individuals each of *C. elphinstonii* were sighted. Unlike the October 1987 sighting, during all these subsequent sightings the Pigeons were seen perched on large branches within the dense canopies of trees in the evergreen patch.

Interestingly, previous avifaunal surveys of Nandi Hills by Salim Ali during his survey of the "Birds of Mysore" on 19 December 1939 and that of Ghorpade *et al.* (1974) did not come across *C. elphinstonii*. During his visit to Nandi, Salim Ali does not seem to have frequented the evergreen patch as his notes do not include the species like Blacknaped Oriole *Oriolus chinensis* Linn., Blueheaded Rock Thrush *Monticola cinclorhynchus* (Vigors), Whitethroated Ground Thrush *Zoothera citrina cyanotus* (Jardine & Selby) and Blackbird *Turdus merula* Linn. which frequent this evergreen patch. In fact we have also come across Indian Blue Chat *Erithacus brunneus* (Hodgson) and Pied Ground Thrush *Zoothera wardii* (Blyth) wintering in the same evergreen patch at Nandi Hills (Prasad *et al.* unpublished). Also during their previous two visits to Nandi Hills by Ghorpade *et al.* (1974) seems to have not surveyed the patch carefully, for they have not mentioned the species in their articles.

Nilgiri Wood Pigeon is considered to be a resident species partial to moist inter belt and confined to the evergreen biotope of the Western Ghats, Anaimalais, Nilgiris, Palnis and hills of western Karnataka (Ali and Ripley 1987). Salim Ali (1943) has recorded the species at Biligirirangana Hills. Our sighting of the species at Nandi Hills during several visits appears to be the first ever record of the species outside its designated distributional range and in the inland



Deccan plateau.

According to our observations on the behaviour of *C. elphinstonii* at Nandi Hills, the species was frequently sighted during early mornings and late evenings when the birds were active. The wood pigeons roosted in thick canopied trees during the hot hours of the day when disturbance to the area caused by the visiting tourists was maximum. The birds were observed to be extremely shy and preferred to hide in the thick canopy once disturbed.

July 15, 1994

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### 17. INDIAN BLACK DRONGO *DICRURUS ADSIMILIS* (BECHSTEIN) FEEDING ON A SMALL BIRD

While doing a survey of wild animals in Chinnar Wildlife Sanctuary, Kerala (between 10° 15' to 10° 22' N latitude and 77° 05' to 77° 17' E longitude), on 8 March 1989, a Black Drongo (*Dicrurus adsimilis*) was noticed perched on a tree branch feeding on a small bird. After sighting us the drongo moved away to another tree with the prey. When we followed it dropped the prey, which was identified as a Tickell's Blue Flycatcher *Muscicapa tickelliae*.

Ali and Ripley (HANDBOOK) reported that birds such as *Prinia*, *Zosterops* and *Aegithina* as taken by the Black Drongo. Sridharan and Sivasubramanian (JBNHS 83:212-3) have also recorded Black Drongo feeding on Indian Wren

Warbler (*Prinia subflava*) in Keoladeo National Park at Bharatpur. D'silva *et al.* (ibid. 87:301) also reported Black Drongo feeding on a small bird presumed to be a martin.

Earlier reports have indicated that Black Drongo tends to feed on birds when the availability of insect food is comparatively low. The present observation of Black Drongo feeding on a bird was made in the month of March when the insect availability may also be low.

December 17, 1992

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# 18. ASHY MINIVET *PERICROCOTUS DIVARICATUS* (RAFFLES) IN HIMACHAL PRADESH

Today morning, I looked out of my window at the sunlit mountains glistening in brilliant sunlight at the upper end of the Beas Valley. Invariably, there are birds flitting around. Today, I noticed a minivet flitting about in an apple tree further down. Minivets, even the females flicker, not flit and I was struck by the absence of any yellow in the wings and tail which struck me as unusual. The bird flew right up and I watched it through the window pane within a distance of a couple of yards. There was no indication of pink or yellow. What struck me was the broad white forehead against a black head (like that of a pied wagtail), the back was grey, the lower parts white. The tail, where usually the colour was distinctly black with conspicuous outer white feathers. My immediate reaction was that

I was possibly looking at the female of my first Rosy Minivet, *P. roseus*.

Looking at the plate 66 of the 'A PICTORIAL GUIDE TO THE BIRDS OF THE INDIAN SUBCONTINENT' I noticed that *roseus* has yellow. The bird I saw was undoubtedly *divaricatus*. I would appreciate your publishing this record in the Journal with a qualifying note by you indicating the birds range and its sightings in the subcontinent.

March 22, 1993

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# 19. EXOTIC DIET OF WHITEHEADED BABBLERS *TURDOIDES AFFINIS* (JERDON)

Among the many birds that inhabit our wooded land on the outskirts of Madras are Whiteheaded Babblers *Tudoides affinis* (Jerdon). A flock of these birds (6 to 10) lost their natural shyness and started visiting our home, invading our well-ventilated dining room, a few years ago. With each new generation they are getting bolder and now-a-days share our dining table with us and clamour to be fed especially at breakfast time. They share whatever we eat. The

staple is bread crumbs and rice preparations, such as iddlies crushed into small pieces. However, they do not care for plain cooked rice. If they can get their beaks into choice items, such as, butter, scrambled eggs, grated coconut they love it. They are not averse to fish and meat preparations if the pieces are small enough.

September 28, 1992

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# 20. THE LESSER WHITETHROAT *SYLVIA CURRUCA* (LINN.) IN KERALA

Kerala has not been included in the wintering range of any of the four races of the

Lesser Whitethroat *Sylvia curruca* (Linn.) either in the HANDBOOK (Salim Ali 1983) or in the



SYNOPSIS (Ripley, S.D. 1982). Salim Ali has not included this species in 'BIRDS OF KERALA' (1969) also. To the best of my knowledge, this species has not been authentically reported hitherto from Kerala. Here I place on record my sighting of a Lesser Whitethroat at Chithrari, Pattanur village, Kannur dist. on 11th October 1992.

Mattanur village lies about 25 km NE of Kannur (Cannanore), 200 m above msl. Major part of this village is lateritic hillocks planted with cashew *Anacardium occidentale*. Within these plantations, where there is not sufficient soil, patches of thorny scrub are present. *Randia* sp., *Zizyphus* sp. etc along with lantana and patches of Eupatorium (*Chromolaena odorata*) are the predominant vegetation of this scrub. The Lesser Whitethroat was seen in such a scrub.

I could observe the bird for more than an

hour as it hunted actively amongst the twigs and leaves of the thorny bushes. It spent 5-6 minutes in each bush, gleaning caterpillars and insects. Once it alighted on the ground below a bush to pick up a morsel. Not much wary, on one occasion it perched on a bush just a metre away from me. It called thrice during my observation - a harsh, but not loud *kreesh* uttered with fully opened beak. It was seen feeding in the foliage of a cashew tree also, at about 4.5 m height. Franklin's Wren Warbler *Prinia hodgsonii*, Tailor Bird *Orthotomus sutorius*, Leaf Warbler *Phylloscopus* sp., etc. were seen hunting on the same bush with this bird at times.

December 31, 1992

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## 21. BLACK REDSTART *PHOENICURUS OCHRUROS* (GMELIN) AND SOUTHERN SMALL MINIVET *PERICROCOTUS CINNAMOMEUS* (LINN.) NEW BIRD RECORDS TO POINT CALIMERE WILDLIFE SANCTUARY

In Tamil Nadu, the Black Redstart *Phoenicurus ochruros* is known to winter only in Palni Hills in the Western Ghats (Ali & Ripley 1983). In October 1984 one male Black Redstart was sighted at Kodikkarai (just outside the Point Calimere Sanctuary limit) on the ground under a *Prosopis chilensis* bush. The bird was also shown to my colleagues Dr. R. Sugathan and P. Balasubramanian. The bird stayed for about three days and left. In the plains along the east coast the bird was recorded up to Sriharikota where one individual was ringed under the Bird Migration Project of BNHS. I was under the impression that the species was included in the checklist of birds of Point Calimere, but after re-checking the list and other published articles found that it has not been reported earlier. The occurrence at Point Calimere is also a range

extension to southeast India.

Though the distribution range of the Southern Small Minivet *Pericrocotus cinnamomeus* includes Tamil Nadu, its occurrence in the plains of Tamil Nadu is not documented. The bird migration and other related studies conducted at various parts of south India in the past 12 years show that there is no record of this species from areas monitored. On 9th July 1992 one female minivet was sighted on a neem tree *Azadirachta indica* in front of the BNHS Research Station's Field Office at Kodikkadu located closer to the Point Calimere Sanctuary. The bird was watched for ten minutes through a pair of binoculars when it was foraging on insects among the foliage. The orange red rump and yellow orange below the tail, the diagnostic features helped to identify the



species. It was not caught in the mist net which was consistently under operation for the last 12 years.

Its appearance at Point Calimere leads to speculation about its resident status as it was not recorded by any one working on the avifauna of the Sanctuary during the last 12 years. Similarly the invasion of the Southern Ashy Wren Warbler *Prinia socialis*, one of the common species in

the nearby area was recently established (Balachandran and Rosalind 1992). This is the first record of a minivet from the Point Calimere Wildlife Sanctuary.

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Wren Warbler *Prinia socialis socialis* Sykes, in Point Calimere wildlife Sanctuary, Tamil Nadu. *J. Bombay nat Hist. Soc.* 89(3): 377.

## 22. RANGE EXTENSION OF THE SPOTTED FOREST GECKO *CYRTODACTYLUS COLLEGALENSIS COLLEGALENSIS* (BEDDOME 1870)

The species of the genus *Cyrtodactylus* (= *Gymnodactylus*) are stoutly built, arboreal lizards with comparatively short tapering tails, which are probably prehensile and never have subcaudal plates. The coloration is often very conspicuous (Annandale 1913). They are distributed widely in the western and eastern Himalayas, the desert of Kutch, and the forests of Western Ghats, Eastern Ghats and Andamans (Daniel 1983).

On 15 September 1993, when I was searching for frogs at 2020 hr in a nursery, situated at the eastern side of the Sanjay Gandhi National Park (SGNP) (18°55' N; 72°54' E), Borivali, Bombay, I picked up a specimen of *Cyrtodactylus* sp. The Gecko was creeping on the damp floor of the nursery. There was no rain and the air temperature was 22.6°C. The specimen was confirmed as *Cyrtodactylus collegalensis collegalensis* and added to the collection of BNHS (Reg. No. 1427). The

specimen had three pairs of large chocolate brown spots on the head and 5 pairs on the body. The last pair meet at the centre. No large spots on the tail but minute dots were present. The head and the back were covered with minute granular scales and the belly with small roundish scales arranged in imbricate. Body and tail are cylindrical; the tail slightly curved upward.

The morphometric details are as follows; snout to vent 46.9 mm; tail 24.7 mm; head length 13.5 mm; head width 10.0 mm; axilla to groin 19.9 mm; forelimb 9.0 mm; hind limb 9.6 mm; eye to snout 5.6 mm; eye to ear opening 12.3 mm; diameter of eye 3.6 mm; interorbital space 8.0 mm; diameter of the body 8.8 mm; diameter of tail in widest part 6.1 mm; upper labials 8; lower labials 8. Other characters and colour of the specimen matches with the description of Boulenger (1885) and Smith (1935).



The type specimen of this species was first collected by Beddome in 1870 from Balarangams near Yelandur, Karnataka. He also collected specimens from Manar, foot of Nilgiris, High Wavy Hills at Madurai in Tamil Nadu. Smith (op. cit.) reported that all the specimens that he had examined were from south of latitude  $13^{\circ}$  N. BNHS collection record shows that specimens have been collected from Nilambur forest and Calicut in Kerala. Murthy (1985) has stated the distribution of this species as hills of south India.

The only *Cyrtodactylus* species recorded from the SGNP is *Cyrtodactylus deckkanensis*

(BNHS Reg. No. 60). So far the occurrence of the species *Cyrtodactylus collegalensis collegalensis* has not been reported from north of the type locality. Hence the present collection extends the range of occurrence of this species northwards from latitude  $13^{\circ}$  N to  $19^{\circ}$  N.

I thank Mr. Vithoba Hegde, Field Assistant who accompanied me in the field work. I also thank BNHS for supporting the field trips.

March 26, 1994

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### 23. RECORD OF A RARE SKINK *LYGOSOMA LINEATA* (GRAY, 1839) FROM KEVADIA, GUJARAT

We collected a skink from Kevadia (Bharuch District), about 1 km from Sardar Sarovar Dam. This skink had lower eyelid with an undivided transparent disc and weak limbs, each one with four digits, the outer toe being absent. Snout-vent length: 52 mm. Total body length: 102 mm. Colour: golden yellow above with darker dots forming longitudinal lines; below lighter. The animal was found moving on rocks with little assistance from its rudimentary legs. The specimen was identified as *Lygosoma lineata* as per the characters described by Smith (1935). This report constitutes the first record of

the species from Gujarat. This species being reported previously only from western India, between north Kanara and Pune (cf. Smith 1935).

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## 24. A NEW RECORD OF *GARRA GOTYLA STENORHYNCHUS* (JERDON) (TELESTOMI: CYPRINIFORMES: CYPRINIDAE: GARRINAE)

During a ichthyofaunal exploration of Nepal-Bihar border ( $26^{\circ}6'$  to  $27^{\circ}5'$  N latitude and  $83^{\circ}8'$  to  $88^{\circ}3'$  E longitude), two species of genus *Garra* were collected, which after examination, were identified as *Garra gotyla gotyla* (Gray) and *Garra gotyla stenorhynchus* (Jerdon). *Garra gotyla gotyla* (Gray) was collected from the river Pandai at Bhiknathori and *Garra gotyla stenorhynchus* (Jerdon) from the river Gandak at Balmikinagar. The identification of these specimens has been confirmed at the Zoological Survey of India, Calcutta. A perusal of existing Indian literature on the ichthyofauna including Das (1939), Hora (1921, 1922, 1923, 1937), Jhingran (1956), Menon (1950, 1974), Motwani and David (1957), Rooj (1971) and Venkateswarlu (1974) reveals that *Garra gotyla stenorhynchus* (Jerdon) was not known earlier from Bihar. Hence the

present collection and the distributional notes of this species would be of interest in highlighting the extended range of distribution in new areas not recorded earlier. The identification of specimens is based on Menon (1974) and Mishra (1982).

**Zoogeographical distribution:** Earlier reported from the Cauvery and Krishna drainages and Western Ghats; the present record from Bihar is of special interest.

*Garra gotyla stenorhynchus* (Jerdon) is of no interest to fisheries.

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## 25. ON THE COLORATION OF *ROHTEE OGILBII* SYKES (PISCES : CYPRINIDAE : CYPRININAE)

(With a text-figure)

*Rohtee ogilbii* Sykes was described over 150 years ago (see Day 1878, Jayaram 1981, Talwar and Jhingran 1991 for details). Sykes (1841) mentioned the colour of the fish as 'reddish - purplish silvery on the back, softening into silvery below'. The species was named by Sykes after his good friend and naturalist Mr. Ogilby. However, there was no information on the colour of the young.

Day (1878), in his FISHES OF INDIA, stated the colour to be 'purplish silvery along the back, becoming silvery white from about four rows of scales above the lateral line .. the young sometimes have a dark spot at the base of the caudal fin, and 4 or 5 narrow black bands

illustration of the colour bands in the very young *Rohtee* (around 3 cm or less). However, there is an illustration of a somewhat larger specimen (see Hora 1937).

Earlier, in 1977-78, the senior author (HVG) had collected young ones of *Rohtee* from the river Mutha, Pune, but, due in all probability to lack of proper illustration and/or specimen for comparison, it could only be tentatively diagnosed as *Rohtee ogilbii*.

During the past two years we have been collecting the fishes found in the rivers Mula and Mutha as well as Neera. We have collected a series of specimens of *Rohtee* (from Mula and Neera) showing the colour bands (Fig.1). The



Fig. 1.

descending from the back to the middle of the side ... '. A similar description is given by Talwar and Jhingran (1991). Again there is no illustration. In fact we could not find any

photographs clearly give the idea of actual coloration and how it changes as the fish grows. *Rohtee ogilbii*: Description of its colour bands.

In all the eight specimens studied, there are



6 vertical bands. Of these 6 bands, in the antero-posterior direction, the first two are predorsal, the third is just beneath the last unbranched dorsal spine, the fourth starts just beneath the last branched ray of the dorsal fin, the fifth is midway between the end of the dorsal fin and the commencement of caudal fin and the sixth is just before the caudal fin.

In a very young specimen (total length = 3 cm, Fig. 1A) all the six bands are complete vertical bands extending from the dorsum to the vertical side. The bands are more or less of uniform breadth. The anterior 3 bands are somewhat thinner and less distinct below the lateral line (LL). Each band is an aggregate of fine black dots spread over 2 to 3 adjacent scale rows (vertical). The distance between the 2 bands is about 6 to 7 scales.

The bands are prominent even in 9 cm and 12 cm fish (Fig. 1B, C), though the bands are fading in the latter specimen. Two 13 cm specimens (Fig. 1D, E) show further fading of the bands, so that in specimen E there is hardly any band apparent unless carefully looked for. In specimens B and C, one can observe that the bands become somewhat broader over LL, and the tail band appears as a black blotch rather than a band.

The bands 2 to 5 are somewhat oblique, going forward and downward while the first band is either straight or going slightly backward and downward. Positionwise, the 6 bands are as follows:

The first band is situated at about half the distance between the dorsal spine and the mouth (predorsal distance), and is slightly oblique. It goes backward and downward behind the operculum and ends just posterior to the origin of pectorals.

The second band is situated at about  $3/4$  the distance between the dorsal spine and the mouth. It too is an oblique band, as mentioned earlier,

and it ends under the pectoral fins.

The third band commences just under the dorsal spine and ends just in front of the tip of the pectoral fins (when pressed).

The fourth band commences just beneath the last branched ray of the dorsal fin and ends just between the tip of the pelvic fin and the origin of the anal fin.

The fifth band starts midway between the end of the dorsal fin and the commencement of the caudal fin. It extends ventrally to end above the middle of the anal fin.

The sixth band is situated just before the caudal fin.

In addition to the above bands, there is a triangular dorsal mark on the head of the fish in the area just behind the eyes. This blotch also fades in larger specimens. We feel that such an illustration will be useful to all concerned with fish taxonomy, especially to newcomers for whom old records are not easily available.

#### ACKNOWLEDGEMENTS

We are grateful to the authorities of Modern College for providing facilities and encouragement. We are also grateful to Dr. K.C. Jayaram for confirming our identification, for reading the earlier draft of this paper and for encouragement. Some of the fishes depicted above were collected by S.L. Lokhande and V.M. Pawar. India Foundation, Pune provided financial assistance to our work. We are indebted to Dr. P.S. Karekar and other authorities of the India Foundation for giving us this assistance.

January 12, 1994.

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## 26. ON THE INDIAN SPECIES OF THE GENUS *GIGALEURODES* QUAINANCE AND BAKER (ALEYRODIDAE: HOMOPTERA) FROM INDIA<sup>1</sup>

(With a text-figure)

A study of the Indian whiteflies of the tribe Dialeurodini Sampson 1943 justified the elevation of the sub-genus *Gigaleurodes* Quaintance and Baker of the genus *Dialeurodes* Cockerell to generic level. Recently Regu and David (1993) reported a new species *Dialeurodes* (*Gigaleurodes*) *splendens* which is now assignable to the genus *Gigaleurodes*. During the present study *G. multipori* (Takahashi) was collected from *Litsea* sp. in Shillong (Meghalaya). This paper briefly defines the generic characters and reports the Indian species of the genus *Gigaleurodes*.

*Gigaleurodes* Quaintance and Baker 1917

**Type-species:** *Dialeurodes* (*Gigaleurodes*) *maxima* Quaintance and Baker, *Proc. U.S. natn. Mus.* 51:426-427, by original designation.

Pupal case oval to subcircular; yellowish to white, without wax; margin crenulate or exceptionally smooth; submargin not separated from dorsal disc, with suture-like lines; a row of subdorsal/submarginal minute setae present;

longitudinal moulting suture generally reaching margin and transverse moulting suture reaching subdorsum; tracheal folds indicated. Without sculpturing, or sometimes covered with minute circular dots, pores distinct with internal teeth or fimbriae; thoracic tracheal furrows indistinct and caudal tracheal furrow distinct. Vasiform orifice small, subcordate, without a comb of teeth; operculum filling the orifice and obscuring the lingula.

*Gigaleurodes* was originally described as a subgenus of *Dialeurodes* by Quaintance and Baker (1917) and in the present study it is elevated to the rank of a genus. It is distinguished from *Dialeurodes* Cockerell by the vasiform orifice without comb of teeth on its inner lateral and caudal margins; thacheal folds without stipples and in having no indication of thoracic tracheal furrows.

### KEY TO INDIAN SPECIES OF *Gigaleurodes* Q. & B.

- 1 Pupal case 0.94-0.96 mm long; cephalic, mesothoracic and I abdominal setae 400-450  $\mu$ m long; metathoracic setae absent ..... *multipori* (Takahashi)

Pupal case 0.76-0.79 mm long; cephalic and I abdominal setae respectively 35-50  $\mu$ m and 17.5  $\mu$ m

<sup>1</sup>Forms part of Ph.D. thesis submitted by the first author to the University of Madras in October 1989.



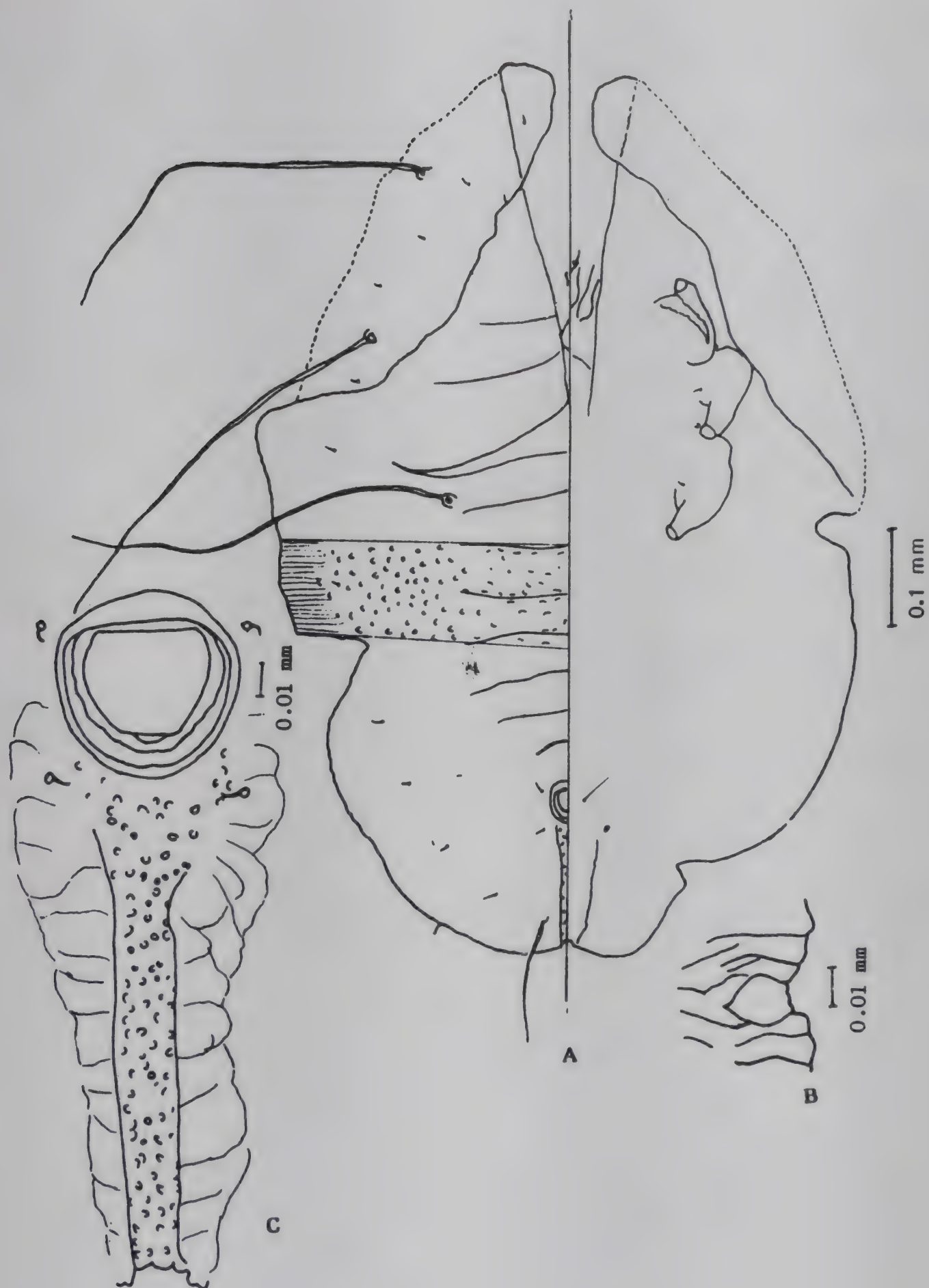


Fig. 1. *Gigaleurodes multipori* (Takahashi).  
A. Pupal case; B. Margin; C. Vasiform orifice.



long; meso- and metathoracic setae 27.5  $\mu\text{m}$  . . . . .  
 . . . . . *splendens* Regu and David

# 1. *Gigaleurodes multipori* (Takahashi) (Fig. 1, A-C)

*Dialeurodes* (*Gigaleurodes*) *multipori*  
 Takahashi, 1932. *Rep. Dep. Agric. Govt. res.*  
*Inst., Formosa*, 60: 11-12.

This species was reported from Taiwan from *Daphniphyllum glaucescens* (Daphniphyllaceae) and this is the first report of this species from India. The following additional descriptive notes are provided.

**Pupal case:** 0.94-0.96 mm long and 0.58-0.59 mm wide.

**Margin:** Irregularly crenulate; anterior and posterior marginal setae respectively 20 and 37.5  $\mu\text{m}$  long.

**Dorsal surface:** Cephalic setae 400-450  $\mu\text{m}$  long, mesothoracic setae 430-450  $\mu\text{m}$  long, I abdominal setae 420-450  $\mu\text{m}$  long, VIII abdominal setae 5-7.5  $\mu\text{m}$  long and caudal setae 225  $\mu\text{m}$  long. Submargin with suture-like lines running mesad from margin, with a row of about 12 pairs of setae, 5  $\mu\text{m}$  long, and dorsum with semicircular markings. Caudal tracheal furrow indicated with circular dots while thoracic tracheal furrows invisible. Vasiform orifice as long as wide (42.5-50.0  $\mu\text{m}$ ); operculum 25-30  $\mu\text{m}$  long and 30-35  $\mu\text{m}$  wide; lingula concealed. A pair of setae at the posterior end of vasiform

orifice, 7.5  $\mu\text{m}$  long distinct.

**Ventral surface:** Ventral abdominal setae 35  $\mu\text{m}$  long and 45  $\mu\text{m}$  apart. A pair of minute setae at the base of rostrum evident. Seta at base of meso and metathoracic legs evident.

**Hosts:** INDIA: *Litsea* sp. (Lauraceae); TAIWAN: *Daphniphyllum glaucescens* (Daphniphyllaceae).

**Distribution:** INDIA: Shillong and Nongkhaw (Meghalaya); TAIWAN: Sozan.

**Material examined:** 13 pupal cases, *Litsea* sp., Shillong, 29.9.1988, coll. B.V. David; 4 pupal cases, unidentified plant, Nongkhaw, 1.10.1988, coll. B.V. David.

# 2. *Gigaleurodes splendens* Regu and David

*Dialeurodes* (*Gigaleurodes*) *splendens* Regu and David, 1993. *J. Bombay nat Hist. Soc.* 89: 82-87.

**Host:** *Homonoia riparia* (Euphorbiaceae).

**Distribution:** INDIA: Rajapalayam (Tamil Nadu).

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October 27, 1993

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## 27. RECORD OF A NEW LARVAL PARASITOID ASSOCIATED WITH *ANTIGASTRA CATALAUNALIS* (DUP.) (LEPIDOPTERA: PYRALIDAE)

*Antigastra catalaunalis* (Dup.) is a most destructive pest of sesamum (*Sesamum indicum* L.). During the course of population studies of the pest during 1989 and 1990 under the agro-climatic conditions of western Uttar Pradesh, four hymenopteran parasitoids were found associated with the field population. The activities of the parasitoids started with the termination of rainfall from mid September and reached to maximum by the end of October, when the pest was in the peak of its multiplication. Parasitization by *Phenerotoma* sp. was severe followed by *Apanteles* sp., *Elasmus brevicornis* Gahan and *Trathala flavo-orientalis*

(Cameron) being 19.17, 16.92, 15.49 and 13.85% respectively. *Phenerotoma* sp. has not been reported earlier associated with *A. catalaunalis*, hence parasitization by this parasitoid is the first record of the pest from western Uttar Pradesh.

October 11, 1993

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## 28. A REPORT ON THE GENUS *NEOPODOCINUM* OUDEMANS (ACARINA: MACROCHELIDAE) FROM INDIA

### INTRODUCTION

The genus *Neopodocinum* was erected by Oudemans (1902) designating *N. jaspersi* (Oud.) as the type species, which now comprises a little over 20 species. Krantz (1965) contributed significantly by describing 11 species on a global basis. Other recent contributions were made by Micherdzinski (1964), Sellnick (1968), Petrova (1970), Costa (1966, 1975), Iavorschi (1975), Samsinak and Daniel (1978), Chang-Chiang and Chang (1980). Members of *Neopodocinum* are usually phoretic with scarabaeid (Petrova and Taskaeva 1968), trogid and geotripid beetles (Krantz 1965) and also mammals (Ambross 1984, Haitlinger 1984). Adults and all nymphal stages are phoretic, collection records are mostly from the phoretic

partners. Only in recent years *Neopodocinum illincae* Iavorschi has been collected from forest litter from Rumania (Iavorschi 1975). The genus is not world wide in distribution. They are only confined to the tropical, sub-tropical and temperate regions of Asia, Africa and Europe, i.e. in the eastern hemisphere and have never been recorded from the western hemisphere.

The genus is little known in India. Only 3 species are so far known from the country. During a survey of the macrochelid mites *N. jaspersi* (Oudemans) and *N. setsum* Krantz have been collected from India. Further extensive collection of coprophagous scarab beetles may lead to the recovery of additional species since they are largely phoretic on Scarabaeidae. Unless otherwise mentioned collections have been made by the author.



**Neopodocinum rhinolophi (Oudemans)**

*Neopodocinum rhinolophi* (? deutonymph)  
Oudemans, 1914, *Ent. Ber.* (Nederland), 4: 67;  
Oudemans, 1915, *Archiv. für. Naturgesch.*  
Berlin, 81: 122; Vitzthum, 1926, *Treubia*, 8: 41.

**Remarks:** Oudemans (1914) described *Neopodocinum rhinolophi* based on a single specimen collected from a beetle species of the genus *Rhinolophus* in Khandala, Bombay. On the basis of peritreme length he considered it to be a protonymph. In a later paper (1915), he stated that it resembled a deutonymph. According to Krantz (1965) the specimen in question has the following deutonymphal characteristics: four pair of sternal setae; an incised dorsal shield, two setae on palptrochanter. Krantz (1965) in a review of the genus on a global basis failed to locate *N. rhinolophi* in Oudemans's types in Leiden and stated that the confusion connected with the original and subsequent descriptions of *N. rhinolophi* by Oudemans (1914, 1915) cannot be solved.

**Neopodocinum jaspersi (Oudemans)**

*Laelaps jaspersi* Oudemans, 1900 *Tijdschr. v. Ent.*, 43: 72. *Neopodocinum jaspersi* Oudemans, 1903, *Tijdschr. v. Ent.*, 45:25; Berlese, 1911, *Redia*, 7: 431; Berlese, 1917, *Redia*, 12:153; Vitzthum, 1926, *Treubia*, 8: 41; Krantz, 1962, *Acarologia*, 4: 159; Micherdzinaski, 1964, *Acarologia*, 6: 239; Krantz, 1965, *Acarologia*, 7(2): 174.

**Material examined:** 2 females, INDIA: Assam: Dibrugarh, on *Copris* sp., 10. vi. 1976; 3 females, Dibrugarh, on *Catharsius molossus* (L.), 10. iv. 1978; 1 female, Tinsukia, on *Copris* sp., 10. iii. 1976; 2 females, 2 males, 3

protonymphs and 3 deutonymphs, Nowgong District, Lumding, on *Copris* sp., 10. iii. 1980; 1 female, Karnataka: Mysore, on *Heliocopris bucephalus*, collection date and collector unstated (material in Entomology Department, University of Agricultural Sciences, Bangalore); 1 female, 7 protonymphs and 4 deutonymphs, Bangalore, on *Heliocopris midas* (F.), collection date and collector unstated (material in UAS, Bangalore); 2 females, Madhya Pradesh: Jabalpur Dist., Pachpedi, on *Heliocopris phalus*, collection date and collector unknown (material in Acarology Section, Zoological Survey of India, Calcutta); 1 female, Rajasthan: Jodhpur, on *Heliocopris* sp., collection date and collector unstated (material in Acarology section, ZSI, Calcutta); 3 protonymphs, Uttar Pradesh: Almora, soil litter, 10. x. 1976; 3 females and 2 males, West Bengal: Nadia district, Ranaghat, on *Catharsius molossus* (L.), 13. viii. 1964, coll. Dr. S.K. Bhattacharyya.

**Distribution:** Europe (Holland) and Asia (Java & India). INDIA: Assam, Karnataka, Madhya Pradesh, Rajasthan and West Bengal. (Except Madhya Pradesh all are new records).

**Remarks:** Krantz (1965) redescribed *N. jaseprsi* which emended and enlarged earlier description by Oudemans. The holotype of *jaspersi* was reported to be collected at Amsterdam, Holland by Oudemans (1902). It was believed to be introduced into Holland as collection. Data indicate *jaspersi* to be an inhabitant of tropical and semi-tropical region. Additional collections of *jaspersi* are from "Asia" and "Java" as represented in Berlese collections at Florence, Italy (on *Copris molossus*). Krantz (loc. cit.) utilized additional material collected off *Heliocopris* sp. at Jabalpur, Madhya Pradesh. In the present investigation the species has been collected from Assam,



Karnataka, Madhya Pradesh, Rajasthan and West Bengal.

***Neopodocinum setosum* (Krantz)**

*Neopodocinum setosum* Krantz, 1965, *Acarologia* 7(2): 189-190.

**Material examined:** 3 females, INDIA: Assam: Dibrugarh, on *Catharsius molossus* (L.), 10. vi. 1976; 4 females, Nowgong District, Lumding, on *Catharsius* sp., 10. iii. 1980; 2 females, Karnataka: Bangalore, on *Catharsius capucinus*, 10. vii. 1986; 1 female, Tamil Nadu: Coimbatore, on *Heliocopris* sp., 10. iii. 1981.

**Distribution:** INDIA: Assam (new record) and Karnataka.

**Remarks:** The original description of *N. setosum* was based on females collected only in India. Details of collection data are as follows: three females off *Catharsius capucinus* F., exact locality unstated; one female from Shimoga, Mysore (ex *Catharsius capucinus* F.). During the present survey altogether 10 females were collected from Assam, Karnataka and Tamil Nadu. Males and other nymphal stages are unrepresented in the collections.

June 26, 1993

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## 29. TWO NEW RECORDS OF CLADOCERA OF THE GENERA *ECHINISCA* LIEVIN AND *DISPARALONA* FRYER FROM INDIA

(With eight text-figures)

*Echinisca capensis monodi* (Gauthier, 1930) and *Disparalona rostrata* (Koch, 1841) were found during study of Tripura State zooplankton and are recorded in India for the first time. Redescriptions are given with remarks.

Family MACROTHRICIDAE Baird, 1843  
Genus *Echinisca* Lievin, 1848

1. *Echinisca capensis monodi* (Gauthier, 1930) (Figs. 1-5).

FEMALE: Body size 0.92 mm. Shape oval; dorsal margin broadly rounded, postero-dorsal corner distinct with or without projection (Figs. 1-2). Head broadly rounded anteriorly, rostrum slightly pointed, labrum concave with round protuberance in the middle. Eye large, ocellus small situated nearer the rostrum than to the eye. Antennules long and slender with a long sensory seta near the base, distal half armed with 3 sharply pointed spines, distal end with spinules and long sensory setae (Fig. 3). Antennule typical of the genus, the longest setae armed with a series of fine setules and large spines in between, which decrease in size distally (Fig. 4). Carapace convex dorsally, ventral margin evenly rounded, with a series of long setae at the postero-ventral corner. Postabdomen bilobed; dorsal-distal margin rounded with 4 to 5 denticles and scattered groups of short spinules up to the anal groove; anal groove slightly concave with flap-like structure projecting beyond the dorsal margin; preanal margin slightly convex with a series of marginal denticles decreasing in size proximally (Fig. 5).

**Occurrence:** Several females were collected

from littoral regions of Gumti reservoir, Jotanbari subdivision, Tripura State, India.

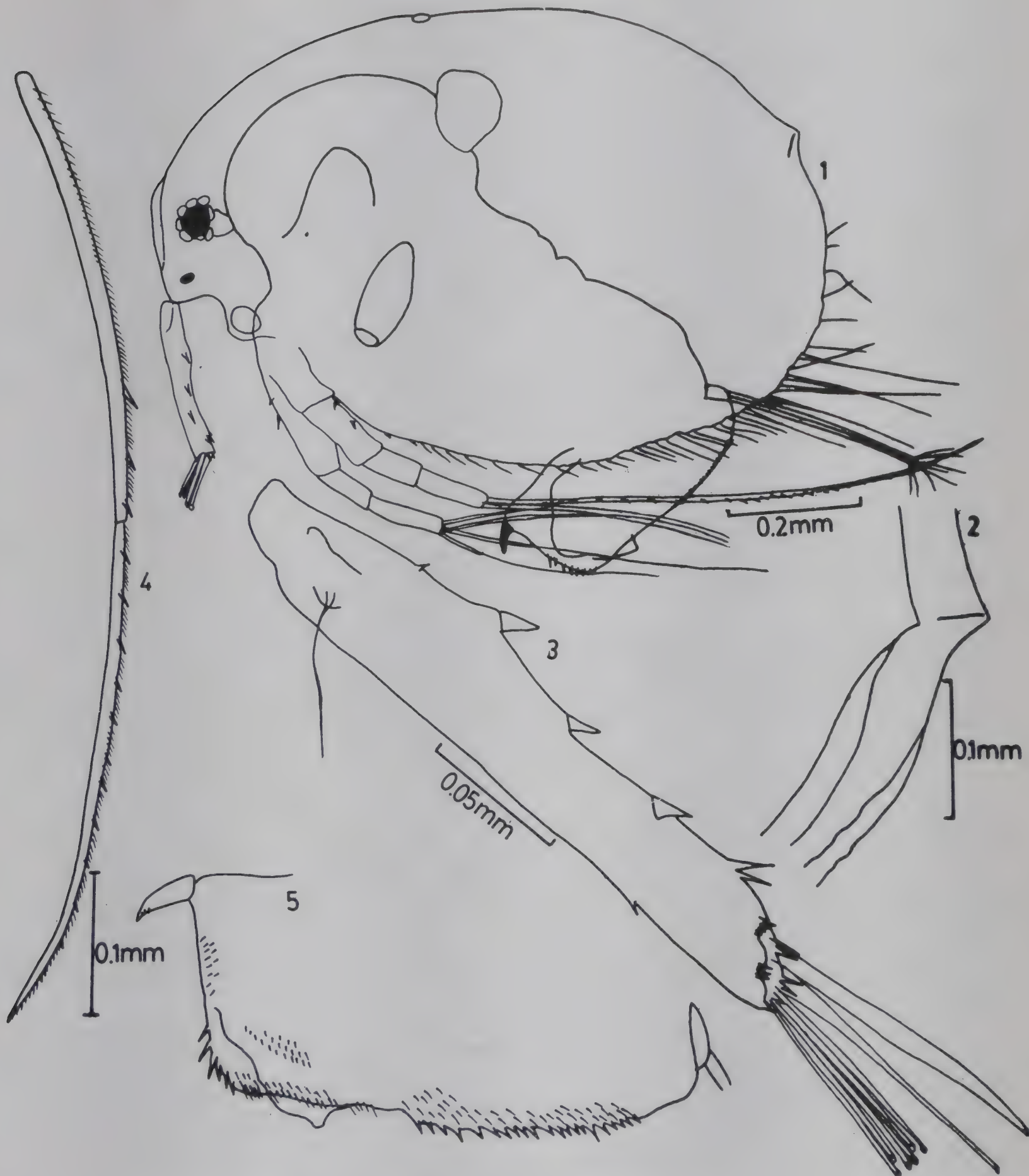
**Remarks:** The present material agrees closely with the descriptions by Smirnov (1974) and Idris (1983) in the presence of 3 sharply pointed spines on the distal half of the Antennule (Fig. 4), with a flap-like structure projecting beyond the dorsal margin of the postabdomen (Fig. 5) and the round protuberance on the ventral margin of the head. However, it differs in the presence of a series of long setae in the postero-ventral corner of the carapace and the absence of projecting postero-dorsal corner of the valve. The two above mentioned characters are also found in *M. malaysiensis* which Idris and Fernando (1981) described from Malaysia. The present species resembles yet another species, *Macrothrix sumatrensis* (Brehm, 1933) in the structure of antenna, round protuberance on the ventral margin of the head and flap on the postabdomen. *E. capensis monodi* is recorded in Sri Lanka (Rajapaksa and Fernando 1982), Malaysia (Idris 1983) and Africa (Ray and Saint-Jean 1969). This is the first record of this species in India.

Family: CHYDORIDAE Stebbing, 1902  
Subfamily: Chydorinae Frey, 1967  
Genus: *Disparalona* Fryer, 1968

2. *Disparalona rostrata* (Koch 1841) (Figs. 6-8).

FEMALE: Body size 0.63 mm. Shape oblong, maximum height in the middle (Fig. 6). Valves with distinct longitudinal lobes. Ventral margin of valves convex with a series of setae.

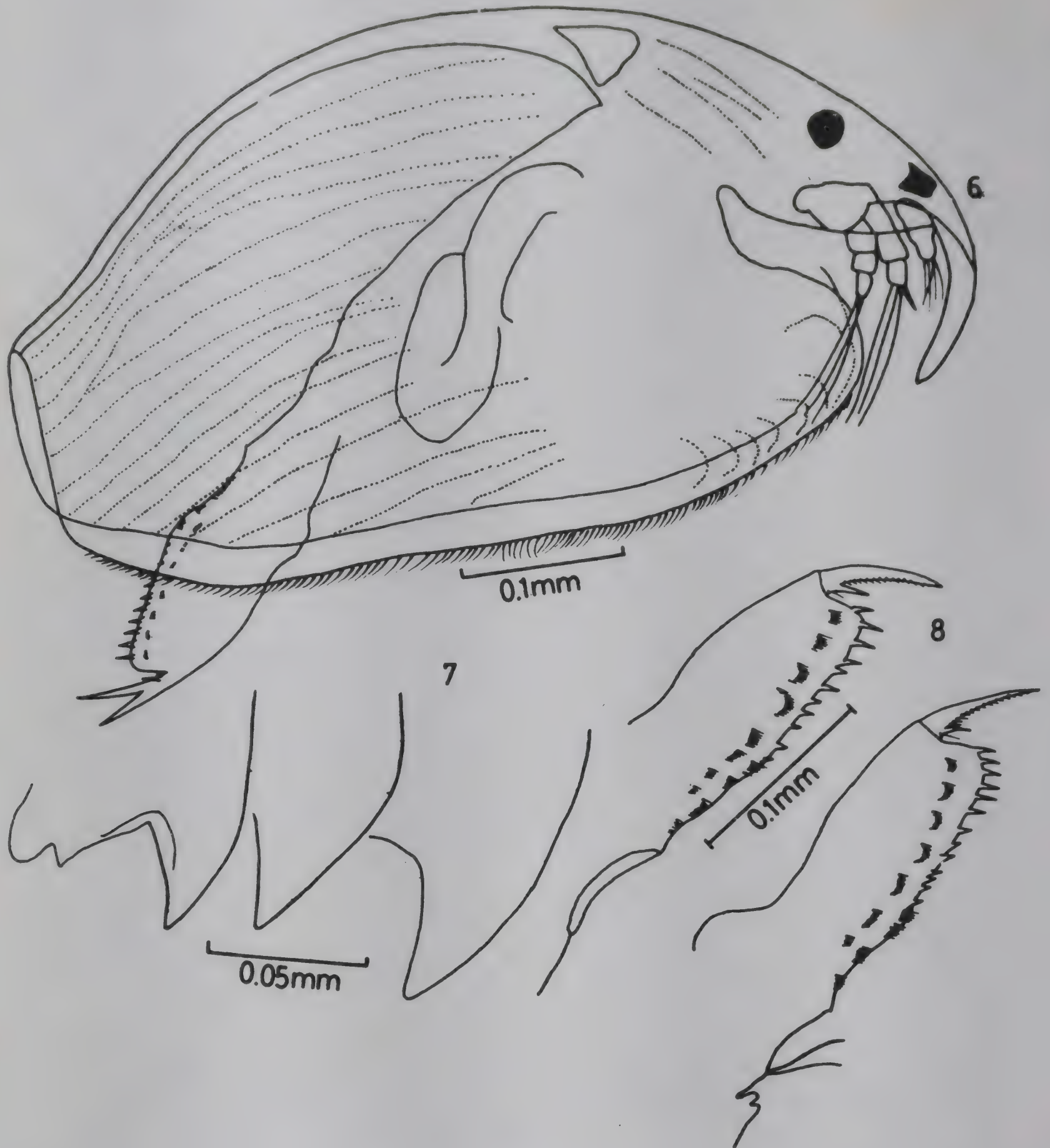




Figs. 1-5. *Echinisca capensis monodi*: Female

1. Lateral view; 2. Posterodorsal corner; 3. Antennule; 4. Longest seta of the antenna; 5. Postabdomen.





Figs. 6-8. *Disparalona rostrata*: Female  
6. Lateral view; 7. Labrum; 8. Postabdomen.



Rostrum long and curved ventrally. Ocellus slightly smaller than eye, situated closer to the eye than to the apex of rostrum. Plates of labrum narrow with pointed apex (Fig. 7). Postabdomen relatively long and slender, dorsal-distal margin gradually rounded, anal groove concave, with distinct preanal corner. 10-12 anal denticles attached submarginally, followed by groups of spinules along the anal groove; lateral side with 6-8 groups of short setules. Claw long, setulated along the concave surface and with 2 basal spines (Fig. 8).

**Occurrence:** Several females from weedy ponds of Sonamura, Manu and Rajnagar subdivisions of Tripura State, India.

**Remarks:** The present material agrees well with the description of *Disparalona rostrata rostrata* (Koch) (Smirnov 1974) except for the absence of spines on the postero-ventral corner of the valves and the presence of two basal spines on the claw. However, Idris and Fernando (1981) reported that these variations are not

major since it is found that even though the denticles in the postero-ventral corner are present, they vary from 1-3 and sometimes are absent in the same individual. However, Michael and Frey (1984) reported that the drawings of *D. rostrata* by Idris and Fernando (1981) and Idris (1983) lack many details and further stated that the species available in Eastern Asia is different from the European forms. Further studies on this will prove the real status of the present species.

## ACKNOWLEDGEMENTS

I thank the Director, Zoological Survey of India for facilities provided, and Dr. S.K. Tandon, Joint Director for encouragement. I gratefully acknowledge the help of Shri S.R. Das for assisting in collection of the specimens from Tripura State.

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### 30. NEW RECORD OF MANGROVE CLAM *Geloina erosa* (SOLANDER, 1786) FROM THE WEST COAST OF INDIA

(With a plate and a text-figure)

Prashad (1932) reported the occurrence of three species of mangrove clam belonging the subgenus *Geloina* in the Indo-Pacific region. The species are *Geloina erosa* (Solander, 1786); *G. bengalensis* (Lamarck, 1818) and *G. expansa* (Mousson, 1849). Interestingly *G. bengalensis* has been reported from Sri Lanka (Preston 1911), Malay Archipelago (Bentham-Jutting 1954) and in Coleroon estuary on the south east coast of India (Natarajan 1976). A detailed literature survey revealed that except the report of Prashad (1932) no information is available on the occurrence of *Geloina erosa* from Indian waters.

During a routine collection of the benthic fauna of a mangrove creek, a single live specimen of *Geloina erosa* was collected from Chorao, a deltaic island located in the catchment of a Mandovi estuary (Lat.  $15^{\circ}31'$ , Long.  $73^{\circ}51'$ ; Fig. 1). The habitat is surrounded by thick mangrove vegetation of *Avicennia* spp., *Sonneratia alba* and *Rhizophora mucronata* (Jagtap *et al.* 1993). Sediment at the sampling site was composed of loose mud with very high percentage of silt and clay and rich in organic matter (Jagtap 1987). The specimen of *G. erosa* was found in sediment at a depth of c. 35 cm in a feeding stream. This stream usually gets drained for about 4 to 6 hours daily during the low tide and remains flooded for the rest of the day. Since the specimen is large in size (length: 105 mm) and was collected from a substantial sediment depth, it could be assumed that it must have been immersed in soft sediment for a long time. Avoiding the desiccation. Morton (1976) has reported *G. erosa* from the Singapore mangrove and, while discussing the general

biology he suggested that *G. erosa* is capable of water and suspended material with subterranean water, possibly takes place via the pedal gape.

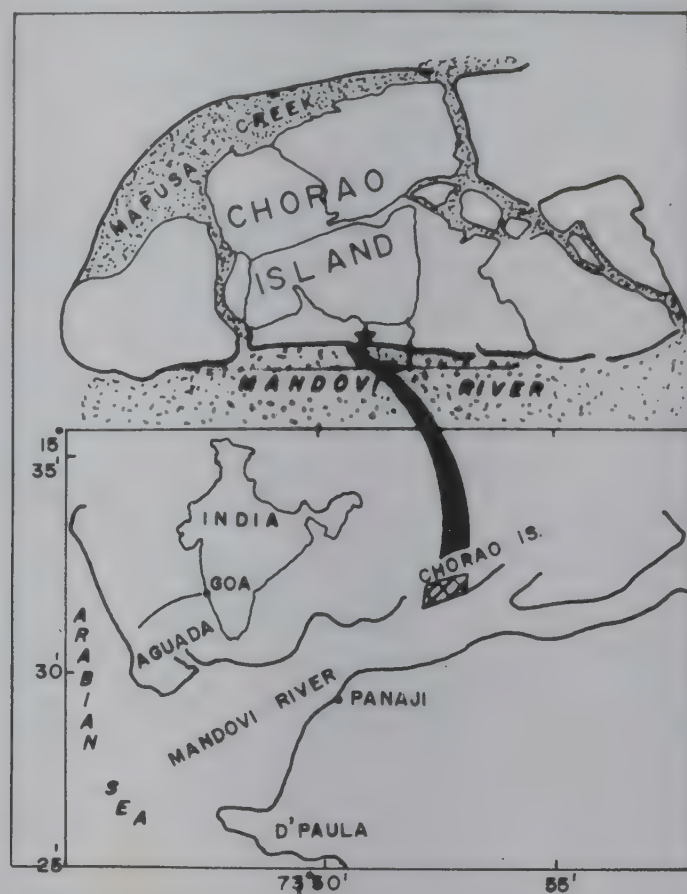
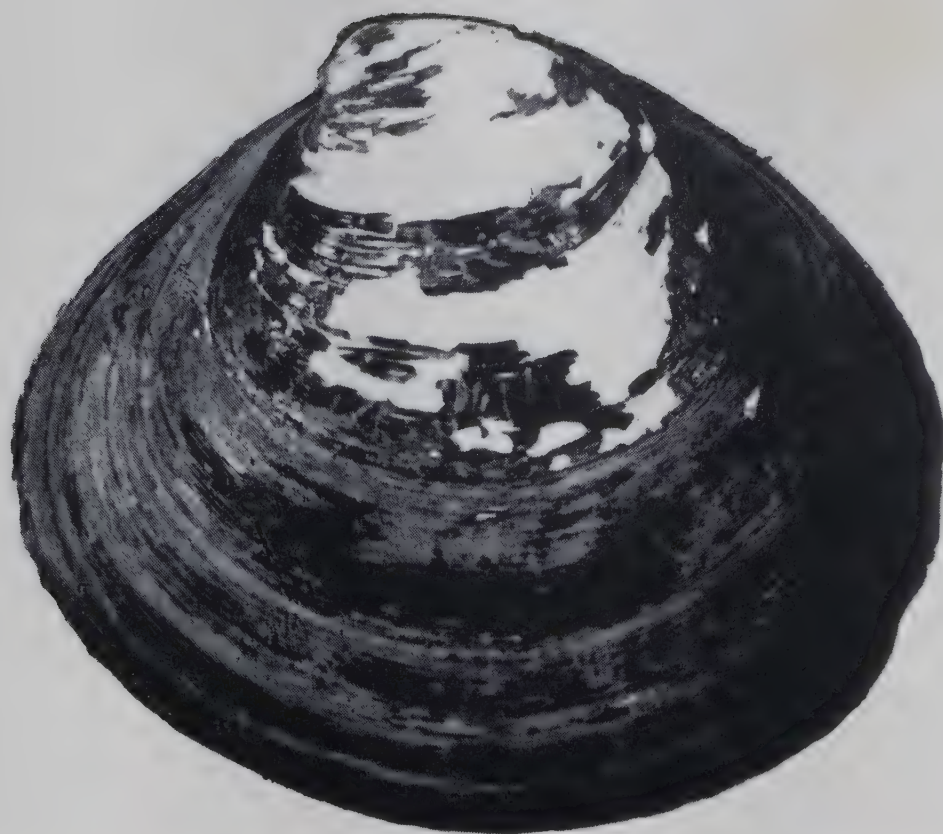


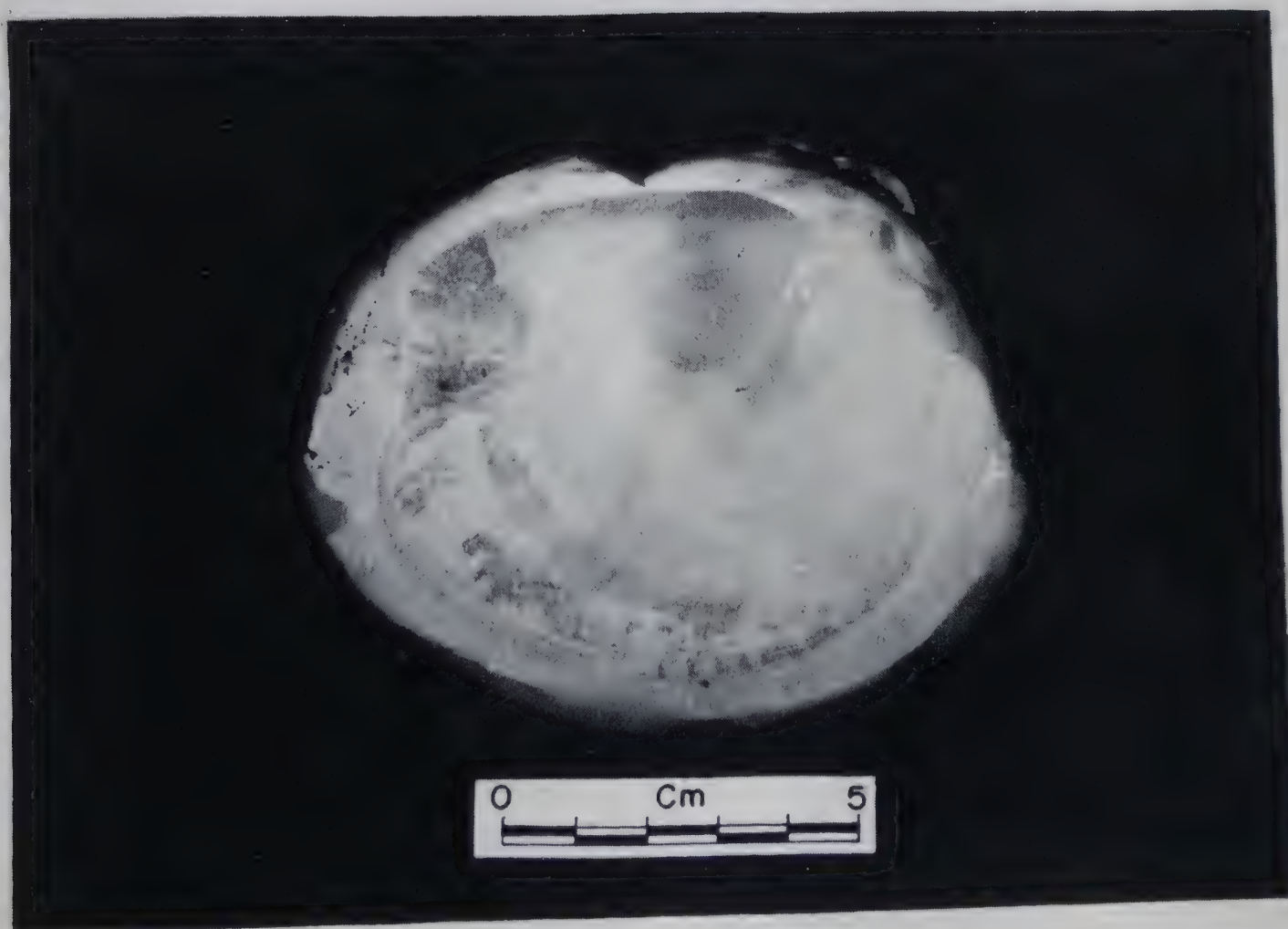
Fig. 1. Location of the sampling site at Chorao Island, Goa.

**Taxonomy:** As seen from Plate 1 the shell of *G. erosa* is thick, almost orbicular with concentric striae on the outer surface and a distinct characteristic flexure extending from the umbo to the mid-posterior margin (Plate 1a). The hinge teeth are strong, larger and antero-lateral tooth located close to the cardinal tooth (Plate 1b). Length (anterio-posterior axis) measures 105 mm; height (dorso-ventral axis) 88.5 mm and width (between the two valves) 56 mm. Ratio of width:height:length was





a



b

a. Outer surface of *Geloina erosa*; b. Internal characteristics of shell.







1:1.58:1.88. Ligament length measures 37.5 mm. The ratio between shell length and ligament length was 1:0.38.

Recently, Morton (1985) reviewed the genus *Polymesoda* (*Geloina*) from Indo-Pacific mangroves and suggested that among the three species reported by Prashad (1932), *G. erosa* is more widely distributed. However, as shown by Morton (1985; Fig. 5), *G. erosa* is mainly distributed in the central part of the Indo-Pacific region, especially in the Malay Archipelago. Since very little is known about the ecology and population dynamics of these ecologically important corbiculacean bivalves, attempts are being made to collect the smaller younger specimens to study their ecology. Secondly the

shells of the various species of *Geloina* are difficult to separate due to their morphological similarities (Morton 1985) and it has led to confusion in subsequent literature with regard to its identification. Therefore, a detailed study leading to taxonomy and ecology of the genus *Geloina* is necessary.

We thank the Director, National Institute of Oceanography, Goa for facilities.

March 28, 1994

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- \* PRESTON, H.B. (1911): Records of Indian Museum, VI.
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### 31. *CYPHOSTEMMA* ALSTON (VITACEAE) - A NEW GENERIC RECORD FOR RAJASTHAN

Parmar (in Shetty, B.V. & V. Singh, eds. 1987. Flora of Rajasthan Vol. 1: 188-190) recorded three genera of Vitaceae namely *Ampelcissus* Planch. (1 species), *Cayratia* Juss. (1 species) and *Cissus* L. (1 species) as

occurring wild in Rajasthan. In addition a cultivated species *Vitis vinifera* L. has been reported. During our recent visit to the Herbarium, National Botanical Research Institute, Lucknow (LWG), we came across a



fruiting specimen of Vitaceae collected from Kota, Shahabad forest (Rajasthan) wrongly identified as *Cayratia trifolia*. Although the leaflets of the said specimen have detached from the petiole, the characteristic seeds helped the senior author in identifying it as *Cyphostemma auriculatum* (Roxb.) P. Singh & Shetty, incidentally a new generic record for the state of Rajasthan.

**Cyphostemma auriculatum** (Roxb.) P. Singh & Shetty in Taxon 35: 596. 1986. *Cissus auriculata* Roxb. Fl. Ind. 1: 430. 1820.

**Specimen examined:** Rajasthan, Kota, Shahabad forest, 12.11.1968., V. Singh 90467

(LWG).

**Notes:** This species was first described under the genus *Cissus* L. by Roxburgh (op. cit.) and Gamble (Fl. Presidency Madras, 1918) transferred it under *Cayratia* Juss. However, the presence of lageniform corolla and disc of four free glands prompted Singh & Shetty (op. cit.) to transfer this species to the genus *Cyphostemma*.

September 2, 1993

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## 32. REDISCOVERY OF TWO RARE ENDANGERED AND ENDEMIC TAXA FROM ANDAMAN ISLANDS

### INTRODUCTION

Andaman & Nicobar Islands are well known for the richness of endemic species. Rao (1986) enumerated 221 endemic taxa as occurring/recorded in the Islands. Balakrishnan (1989) listed 144 endemic species occurring in Andamans only, of which 60 species are known only from type localities and 22 species are those endemics which are subsequently collected from type localities only. These two categories can be definitely grouped as rare and threatened with extinction. This paper reports rediscovery of *Uvaria hamiltonii* Hk. f. & Th. var. *kurzii* King (Family: Annonaceae) and *Aglaia glaucescens* King (Family: Meliaceae). Former species was collected by King's collectors from South Andamans (1890). Parkinson (1923) did not collect this taxon. Balakrishnan and Rao (1983) lists *Uvaria hamiltonii* Hk. f. & Th. var. *kurzii* King under taxa never collected after type collection. However, *Aglaia glaucescens* King

was collected by Parkinson (1923) from Long Island and Guitar Island (Middle Andamans) and around Port Blair (South Andamans). He writes that it is not uncommon. In the recent survey, two taxa were collected after a gap of 100 years and 70 years (approx.) respectively. Both the taxa are highly threatened and vulnerable to extinction. Brief note on habit and distribution is given below.

### Family ANNONACEAE

1. *Uvaria hamiltonii* Hk. f. & Th. var. *kurzii* King.  
Scandent.

**Distribution:** Endemic to Andaman Islands.

**Specimen examined:** South Andamans, Bhatu basti, Garacharama, Fl. & fr. 25th August, 1992, Krishna Kumar 0925. Rare and threatened.



## Family MELIACEAE

2. *Aglaia glaucescens* King.

A small to moderate size tree.

**Distribution:** Endemic to Andaman Islands.

**Specimen examined:** North Andamans, Snehnagar, Inland forest, fl. 7-2-92, *Krishna Kumar* 0389; North Andamans ± 100 metres Saddle peak range, fl. 15-2-92, *Krishna Kumar* 0788. Rare.

## ACKNOWLEDGEMENT

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July 28, 1993

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33. TWO NEW RECORDS OF *CROTOLARIA* L. (FABACEAE) FOR BAY ISLAND

## INTRODUCTION

Willis (1966) gives 550 species of *Crotolaria* L. as occurring in tropics and sub-tropics of which 86 species are represented in the sub-continent. Rao (1986) enumerated 4 species from Andaman & Nicobar Islands. The present paper adds 2 more species of *Crotolaria* L. to these Islands, namely *Crotolaria nana* Burm. from Great Nicobar Island and *Crotolaria wilddenowiana* DC. ssp. *glabrifoliolata* Ellis from Saddle Peak (North Andamans), the highest summit in the Islands. The latter taxon was first described by Ellis (1964) from Coimbatore (Tamil Nadu), the type locality. The present collection could well be the first one from outside the type locality. Habit, Distribution, and ecology for two species are described below.

1. *Crotolaria nana* Burm. Fl. Ind. 156. t.48 fig.2; DC. Prod. ii 127; W. & A. Prodr. 191; Dalz. & Gibs. Bomb. Fl. 56; FBI ii 71. 1879.

Profusely branched, annual, densely silky, hairy herb.

**Distribution:** South-West India, Sri Lanka and Great Nicobar Island.

**Specimen examined:** Great Nicobar Island, 46 km North-South Road on way to Indira Point, flowering 25-10-91, *Krishna Kumar* 0578. Rare.

**Ecology:** In open dry places.

2. *Crotolaria wilddenowiana* DC. ssp.



*glabrifoliolata* Ellis in Bull. Bot. Surv. of Ind. 6(1): 97-98. 1964.  
Herbaceous/suffrutescent.

**Distribution:** Coimbatore and North Andaman Islands.

**Specimen examined:** North Andamans, ± 500 metres on way to Saddle Peak, fr. 18-2-92, *Krishna Kumar 1125*. Rare and threatened.

**Ecology:** In dried, sunny places in the crevices of the boulders.

#### ACKNOWLEDGEMENTS

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### 34. ADDITIONS TO THE FLORA OF MANIPUR FROM DZUKU VALLEY

#### INTRODUCTION

This is a continuation work on the floristic survey of Manipur. The present paper is based on my collection from Dzuku valley, during 1991, during study of the Dzuku lily. From my collection, the following genera - *Aletris*, *Allophylus*, *Argostemma*, *Blepharis*, *Cerastium*, *Chailletia*, *Maytenus*, *Poikilospermum*, and *Pratia* are new for the state. The family Chailletiaceae (Dichapetalaceae) is a new addition to the flora of Manipur.

Dzuku Valley lies on the border of Manipur and Nagaland. The valley extends from 94° 3' 43" to 94° 4' 28" E longitude and 25° 32' 3" to 25° 33' 47" N latitude. The elevation of the valley from mean sea level is 2450-2500 m. It lies on the north-west of Essau mountain (3200 m msl)

which is the highest peak of Manipur. A small stream runs almost south to north through the valley which takes a sharp turn while falling into the main Dzuku river.

#### MATERIAL AND METHOD

In the following enumeration, species are arranged alphabetically within the genera and the families which are also arranged alphabetically.

#### ACANTHACEAE

*Blepharis boehaviaefolia* Pers.: Prostrate herbs. Leaves usually 4 in a whorl, acute at both ends. Flower pink or purple. Capsule ellipsoid, compressed shining glabrous. HB. 3258.

*Peristrophe montana* Nees : Erect spreading



herbs. Leaves elliptic acuminate at both ends, sub-glabrous. Flowers purple. HB. 2192.

#### ASTERACEAE

*Blumea lacera* (Burm. f.) DC. : Large herbs, aromatic. Leaves coarsely toothed. Heads in axillary and terminal, panicle cluster. Flowers yellow. HB. 3343.

*B. mollis* (D. Don) Merr. : Erect villous herbs. Leaves irregularly dentate. Heads many, corolla purple. HB. 3621.

*Eupatorium adenophorum* Spreng. : Glabrous herbs. Leaves rhomboid elliptic. Heads small. Flowers white. HB. 3340.

*Spilanthes oleraceae* Linn. : Annual herbs. Leaves opposite, elliptic ovate. Heads on long peduncle. Flowers white or yellow.

#### CAESALPINIACEAE

*Cassia leschenaultiana* DC. : Softly pubescent erect shrub. Leaves rhachis pubescent with large sessile gland below the lowest pair of leaflets. Leaflets 16-24 pairs. HB. 3285.

#### CAMPANULACEAE

*Pratia numularia* (Lam.) A.Br. & Asch. : Herbs. Leaves alternate denticulate. Flowers green with pink mark. Local name - *Kihom-man*. HB. 2143.

#### CARYOPHYLLACEAE

*Cerastium vulgatum* Linn. : Herbs. Lower leaves spatulate, upper oblong ovate. Flower white in terminal dichotomous cyme. HB. 5589.

#### CELASTRACEAE

*Maytenus thomsonii* (Kars) Raju and Balu :

Small tree. Leaves alternate, lanceolate. Flowers small in yellowish dichasial cymes. HB. 3627.

#### CHAILLETIACEAE (DICHAPETALACEAE)

*Chailletia gelonioides* Hook. f. : Small evergreen tree. Leaves bifarious ovate lanceolate. Flowers polygamo-monoecious in dense cymose clusters. Drupe transversely oblong. HB. 3620.

#### CYPERACEAE

*Eleocharis atropurpurea* (Retz) Presl. : Dwarf, caespitose, culm erect or slightly curved; sheaths purplish. Spikelet ovoid. Achenes obovoid. HB. 2150.

*Fimbristylis scaberrima* Nees : Glabrous, stem compressed. Leaves flat long, robust. Spikelets many, 5-8 flowers, acute, chestnut brown. HB. 5594.

*Scleria laevis* Retz : Stem from woody horizontal rhizome, triquetrous distinctly winged. Leaves acuminate, margin scabrous. Female glume ovate. HB. 5596.

*S. pergracilis* (Nees) Kunth. : Stem trigonous, leafy. Leaves tristichous. Inflorescence unbranched, consisting of clusters of spikelets. Female glume cymbiform. HB. 5532.

#### EUPHORBIACEAE

*Actephila excelsa* (Dalz.) Muel. : Shrubs with grey bark and pubescent twigs. Leaves elliptic oblong. Flowers in axillary clusters. HB. 3238.

*Euphorbia himalayensis* Boiss : Erect herbs. Leaves alternate sessile. Capsule shortly stipulate. HB. 2290.

*E. hypericifolia* Linn. : An erect or spreading herb. Leaves opposite. Capsule glabrous. HB. 503.

*Phyllanthus fraternus* Webs : Annual



glabrous herbs. Leaves distichous subsessile. Flowers axillary. Seeds with parallel ribs. Local name - *Chakpa heikru*. HB. 3282.

## LILIACEAE

*Aletris pauciflora* (Klotzsch) Hard-Mazz. : Scapose herb with fibrous root. Leaves 5-7 nerves. Flowers small white. HB. 5632.

## ORCHIDACEAE

*Calanthe triplicata* (Willem) Ames : Robust evergreen terrestrial orchid. Flowers white, sepals slightly pubescent on the outside. Pollinia 8. HB. 2263.

*Habenaria khasiana* Hook. f. : Terrestrial herbs. Leaves linear not margined. Scape with elongate raceme. Flowers sweet scented, yellow, sepals 3 nerved. HB. 3273.

## POACEAE

*Arundinaria intermedia* Munro : Gregarious caespitose shrub. Culm smooth, sheath glabrous papery, strongly striate. Inflorescence on leaflets stem. Local name - *Tenwa*. HB. 2277.

*Isachne lisboe* Hook. : Stem creeping with long wiry roots. Leaves thin acute finely striate, base rounded. Panicles with the rhachis quite smooth. HB. 5597.

*Cyrtococcum accrescens* (Trin) Stapf : Tall culms, nodes glabrous. Leaf blades linear lanceolate. Inflorescence panicle, smooth and glabrous. Local name - *Kang-mapan*. HB. 2114.

## ROSACEAE

*Potentilla griffithii* Hook. : Erect herbs. Leaves small, leaflets green above and white beneath. Flowers white or yellow. HB. 619.

*Fragaria daltoniana* J. Gay : Filiform

runner, leaflets petiolulate. Flowers solitary. Local name - *Heiron-kak*. HB. 621.

## RUBIACEAE

*Argostemma sarmentosum* Wall. : Small herb. Leaves small, unequal in pairs of whorls. Flowers white in peduncled terminal umbels. Capsule 2-celled. HB. 5330.

## SAPINDACEAE

*Allophylus aporaticus* (Roxb.) Kurz. : Shrub with grey lenticellate bark. Leaves trifoliate. Flowers white clustered on pubescent raceme. HB. 5336.

## URTICACEAE

*Elatostema rupestre* Buch.- Ham. : Small herbs. Leaves subsessile, leaf base oblique. Flowers minute. HB. 3224.

*Poikilospermum suaveolens* (Bl.) Merr. : Evergreen woody climbers. Leaves alternate elliptic. Flowers dioecious. Stamen 2-4. HB. 5324.

## ZINGIBERACEAE

*Alpinia calcarata* Rosc. : Erect herb. Leaves lanceolate, acuminate, glabrous. Flowers crowded on the lower branches of a dense pyramidal panicle with pubescent rhachis. Corolla white. HB. 5550.

*Curcuma caesa* Roxb. : Herb. Leaves broadly lanceolate or oblong, glabrous. Spikes appearing rather before the leaves. Flowers yellow, reddish at the outer border. HB. 3389.

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### 35. OBSERVATIONS ON POLLINATION IN *ALANGIUM SALVIIFOLIUM* (LINN. F.) WANG. (ALANGIACEAE)

#### INTRODUCTION

The plant family Alangiaceae represents a single genus *Alangium* distributed in the tropics and subtropics of the Old World. The genus comprises about 22 species and occurs in the form of trees and less often shrubs (Anon. 1948, Lawrence 1978). Recently a new species, *A. circulare* was described in Malaysia (Stone and Kochummen 1975). Only two species, namely *A. chinense* and *A. salviifolium* occur in India. The species of this genus are cultivated as ornamentals and for timber and medicinal purposes. In the present study, we present some aspects of flowering phenology versus pollination in *A. salviifolium*.

#### POLLINATION IN *A. salviifolium*

*A. salviifolium* is a small deciduous tree found in the drier parts of India and Sri Lanka. It grows vigorously in the forests of South India and Myanmar (Burma) (Anon. 1948). The tree occurs abundantly in Visakhapatnam, Andhra Pradesh, India. We have examined several trees of *A. salviifolium* in Simhachalam, Pedagadili and a single tree in the premises of the Life Insurance Corporation of India residential Quarters in Visakhapatnam. The tree flowers from February to April. Leaf shedding occurs before the start of flowering. Flowering is synchronous in conspecific trees of an area, while it is slightly asynchronous in different areas as has been observed in species such as *Gliricidia sepium* and *Peltophorum pterocarpum* (Aluri and Subba Reddi 1993). It produces flowers in axillary cymes. Flowers open daily in a circadian fashion. The flowers are large with

deflexed petals; bisexual and actinomorphic. The anthers (20-30) being dehiscent longitudinally exposed to the air. The capitate stigma stands above the anthers. Nectar is produced from the nectary situated at the base of the ovary. The nectar analysis for sugars showed that the sugar concentration is 25-29% and contained glucose, sucrose and fructose.

The flowers with stamens exposed to the air are usually considered to be anemophilous. As per the report of Janaki Bai and Subba Reddi (1983), the species does not release pollen into the air so that anemophily can occur. Based on this report, we show that *A. salviifolium* is not wind-pollinated and its floral features indicate adaptation to entomophily.

The flowers being available day and night are foraged by diurnally active insects. The insects include species of bees, wasps, flies and butterflies. The bees collect both pollen and nectar, while the remaining groups forage for nectar only. The flower-form by exposing the stamens and stigma is promiscuous to foraging by any kind of visitor species. The bees comprise *Apis cerana indica*, *A. florea*, *Trigona* sp., *Amegilla* sp., *Ceratina* sp., *Thyreus histrio*, *Pithitis binghami*, *Xylocopa latipes* and *X. pubescens*. The last two species are the regular and effective pollinators throughout the flowering period. The other bees and other groups of insects (wasps - *Ropalidia spatulata*, *Rhynchium metallicum*; fly - *Musca* sp.; Butterflies - *Danaus chrysippus*, *Euploea core*, *Catopsilia pyranthe* and *Pelopidas mathias*) except for a sphingid, *Macroglossum gyrans* are not regular foragers. They exploit the floral food



of *A. salviifolium* only when their primary floral source from other plant species is not available. These foragers, however, act as secondary pollinators and assume great significance in the absence of *Xylocopa* spp. and *M. gyrans*.

*Xylocopa latipes* and *X. pubescens* made regular contact with the reproductive parts and effected pollination during foraging for nectar and pollen. The large-sized bees are perfect and appropriate for the flowers of *A. salviifolium*. The flowers stand out visually and greatly attract the bees from several metres afar. Further, the flowers are very conspicuous by their larger display and by the shedding of leaves. The bees make inter-tree movements and exhibit 'trap-lining' and 'territorial' foraging behaviour. The traplining bees by foraging continuously or alternately greatly promote cross-pollination. The bees that exhibit territoriality select a population of flowers from one to few conspecific trees of an area and guard the floral food of those flowers from intruder insect species by repelling them (Van der Pijl 1954, Janzen 1964, Barrows 1980, Frankie *et al.* 1983, Aluri and Subba Reddi 1989). As the anthesis rate is almost uniform, the amount of nectar flow, temporally, is uniform throughout. Consequently, the bees appear on the flowers at the same frequency and exploit floral forage from sunrise to sunset. Further, the nectar volume and sugar concentration per flower is in accordance with other *Xylocopa*-pollinated flowers such as *Anisomeles indica*, *A. malabarica* and *Gliricidia sepium* (Aluri and Subba Reddi 1989, 1993). The continuous foraging of bees on the tree species effects pollination in numerous flowers daily. The bees forage alternately or shift from one to another species for sometime depending on the richness of floral reward. The other plant species that the bees preferentially forage in the area during the flowering period of *A.*

*salviifolium* include *Gliricidia sepium*, *Peltophorum pterocarpum*, *Cassia* species, *Moringa oleifera* and *Cochlospermum religiosum*. The plant species exhibit different dates of peak flower production. As the carpenter bees are swift fliers and have great capacity to exploit floral reward in a very short time on a single foraging bout, their simultaneous or alternate foraging on the above mentioned plant species do not in any way appear to influence the success of self- or cross-pollination in those plants.

The fast flying sphingid, *M. gyrans* (hawkmoth) forages equally efficiently as *Xylocopa*. The hawkmoth forages in the dim light before sunrise and again after sunset. Since the tree antheses throughout the night too, the amount of fresh flowers accumulated by early morning are so great that it stimulates the intensity of foraging by *M. gyrans*. The hawkmoth forages the flowers very rapidly and moves at speed from one flower to another. It exploits floral forage of almost all of the flowers available by that time and effects pollination. All other foragers appear by sunrise and close their foraging activities by sunset. As soon as they stop foraging, several individuals of hawkmoth appear foraging until it is dark. Although the hawkmoth has limited foraging period, it is as equally efficient a pollinator as *Xylocopa*. Its services in this context assume great significance in the pollination of *A. salviifolium*. From this account, it suggests that the *Xylocopa* species and *M. gyrans* are the principal pollinators of this tree. Since, comparable data from other species of *Alangium* are lacking, the present observations on *A. salviifolium* cannot be compared to other species. However, it is not unreasonable to suggest that the pollination system described here for *A. salviifolium* may be occurring in allied species as they do not differ



much in their floral morphology and floral features (Stone and Kochummen 1975).

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### 36. TWO NEW PLANT RECORDS FOR NEPAL

During floristic survey of Eastern Nepal in July 1989, I collected two exotic taxa of the genus *Alternanthera* Forssk. (Amaranthaceae), namely *A. paronychioides* St.-Hil. and *A. philoxeroides* (Mart.) Griseb., the former from Janakpur and the latter from Birganj and Kathmandu proper. On critical examination of the available literature on the flora of Nepal (including Flora of Kathmandu Valley 1986), these species were found to be new records for the flora of Nepal.

All the specimens of exotic species of *Alternanthera* Forssk. collected and studied from different parts of Nepal are housed in the

Herbarium of Post Graduate Centre of Botany, Gaya College, Gaya. Latest botanical name, taxonomic citation, short description, phenology, ecology and distribution for each taxon have been provided. A key for identification of the two exotic species of *Alternanthera* Forssk. in Nepal has also been designed.

#### KEY TO THE EXOTIC SPECIES OF *Alternanthera* FORSSK. IN NEPAL

1. Decumbent herbs; flowers in long peduncled heads . . . . . *A. philoxeroides*
2. Prostrate herbs; flowers in axillary, sessile heads . . . . . *A. paronychioides*



***Alternanthera paronychioides*** A. St.-Hil., Voy. Distr. Diamans Bresil 2 (2): 439. 1833; Sundar. in J. Bombay nat. Hist. Soc. 53: 525. 1956; Veld. in Blumea 19: 167. 1971; Backer in van Steenis, Fl. Males 1, 6: 916. 1972; Townsend in Dassa. & Fosberg, Rev. Handb. Fl. Ceylon 1: 50. 1980; Matthew, Fl. Tamilnadu Carnatic 3 (2): 1302. 1983; Parmar in Shetty & Singh, Fl. Raj. 2: 723. 1991.

*A. polygonoides* sensu Standley, N. Amer. Fl. 21 (2): 136. 1917. non Linn., 1753.

Much branched, prostrate, mat forming herbs, rooting at the nodes. Stems reddish; nodes pilose. Leaves obovate-rhomboid, hairy, 1-3 cm long. Flowers white in axillary, sub-globose, sessile heads. Bracts and bracteoles scarious. Tepals unequal, outer 3 larger, inner 2 narrower. Stamens 3-5, alternating with sublacerate pseudostaminodes; filaments united at base into a cup. Utricles (sub) orbicular, narrowly winged. Seeds obcordate, faintly reticulate, brownish black.

**Ecology:** Less common; often grows luxuriently in alluvial loamy soil in dry waste places and along roadsides.

**Distribution:** A native of Tropical America, now naturalised in Sri Lanka, Indonesia, India, java and other parts of the old world.

**Flowering and fruiting:** All the year round.

**Specimens examined:** Janakpur, K.K. Mishra 5013, 5016.

***Alternanthera philoxeroides*** (Mart.) Griseb. in Abh. Ges. Wiss. Goett. 24: 36. 1879; Backer in van Steenis, Fl. males, ser. 1, 4 (2):

93. 1949; Mahesh. in Bull. Bot. Surv. India 6 (2-4): 313, f. 1-9. 1965; Mishra in J. Econ. Tax. Bot. 5 (1):225. 1984; Sald. & Rao in Sald., Fl. Kar. 1: 165. 1984; Pangtey & Samant in J. Bombay nat. Hist. Soc. 86 (1): 119. 1989.

*Bucholzia philoxeroides* Mart., Amar. 107. 1825.

*Telanthra philoxeroides* Moq. -Tandon in DC., Prodr. 13: 362. 1849.

*Achyranthes philoxeroides* (Mart.) Standley in J. Wash. Acad. Sci. 5: 74. 1915.

Perennial, aquatic or marshy, decumbent herbs. Stems fistular, longitudinally striate. Leaves lanceolate, obovate, acute to rounded, cuneate at base, 4-7 cm long. Inflorescence usually solitary, axillary, pedunculate, globular head; also terminal and sessile. Tepals 5, glabrous, shining white, subequal, 1 nerved, three or four times as long as bracts. Stamens 5, united at base; pseudostaminodes distinct, lacerate and exceeding the stamens. Ovary globose, dorsally compressed; stigma globose, capitate.

**Ecology:** Less common; growing gregariously in stagnant or slow moving shallow water pools, ditches and marshes.

**Distribution:** An American weed, now naturalised in India, Myanmar (Burma), Indonesia, Thailand and other parts of the old world.

**Flowering and fruiting:** March-July.

**Specimens examined:** Birganj, K.K. Mishra 5009; Kathmandu, K.K. Mishra 5012.

February 12, 1993

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### 37. *SPERMACOCE ASSURGENS* RUIZ & PAVON (RUBIACEAE) - A NEW RECORD FROM ANDHRA PRADESH

(With a text-figure)

*Spermacoce*, a weedy genus of about 150-250 species is distributed in the tropics and subtropics of the world. Sivarajan *et al.* (1987) has recently studied this genus in India and reported 10 species. During our study on Rubiaceae of Andhra Pradesh we collected a specimen which was identified as *Spermacoce assurgens* Ruiz & Pavon. Sivarajan *et al.* (1987) reported its occurrence from Kerala for the first time from mainland India. Our collection from Andhra Pradesh extends the distribution of this species northwards. The citation, detailed description, distribution and illustration is given here for its easy identification. The specimen has been deposited in the Herbarium of Department of Botany, Sri Krishnadevaraya University, Anantapur.

***Spermacoce assurgens* Ruiz & Pavon**, Fl. Peru 1: 60. f. 92. 1798; Verdc. in Kew Bull. 37: 547. 1983.

An annual erect or diffuse herb. Stem minutely pubescent. Leaves elliptic-acute, 1.5-3 x 0.5-0.8 cm, base cuneate, entire margin, apex acute, slightly pubescent on both surfaces, impressely veined, subsessile; stipules cuneate with the base of leaves into a sheath, pectinate, glabrous-slightly pubescent. Flowers in axillary and terminal fascicles, white, hairs like bracts

present; calyx 4, short, 1.5 mm, slightly pubescent, unequal; corolla tubular, lobes 4, 5 mm, only lobes hairy, tube glabrous; stamens 4, filaments 1 mm, anther 0.75 mm; ovary oblong, 2 mm, slightly pubescent, style 1 mm, stigma globose, 0.25 mm. Capsule oblong, 2 x 3 mm, slightly pubescent; seeds ellipsoid, transversely rugose, testa reticulate.

The characteristic feature of this plant is striations on seeds, i.e. on back side.

Rare on the hill slopes of Penchalakona in Nellore district. Fl. & Fr. Sept.-Jan.

**Specimen examined:** Penchalakona (NLR), M.S. Gayathri & D. Ali Moulali 5659.

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April 30, 1993

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Fig. 1. *Spermacoce assurgens* Ruiz & Pavon.: A. Twig; B. Open flower; C. Corolla tube; D. & E. Stamens front and back view; F. Pistil with calyx lobes; G. Fruit; H. & I. Seed front and back view.

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Genus *Spermacoce* Linn. (Rubiaceae) in India. *Proc.*

*Indian Acad. Sci.* 97: 347-358.



## 38. NEW RECORDS OF PLANTS FROM ORISSA

In connection with a survey programme entitled "Floristic studies in the Sanctuaries of Orissa" an exhaustive floristic study was undertaken. After critical scrutiny of all available published literature 4 species turn out as new records for the State of Orissa.

All the specimens are preserved in the Herbarium of Post-Graduate Department of Botany, Utkal University, Bhubaneswar (BOTU).

***Alternanthera paronychioides*** St. Hil., Voy. Distr. Diamans Bresil 2: 439. 1833; Dassanayake, Fl. Ceylon 1: 50-51. 1980; Mathew, Fl. Tam. 2: 1302. 1983.

Prostrate herbs, branchlets rooting at nodes. Leaves elliptic or obovate, villous, apex sub-acute. Spikes clustered, ovoid, sessile. Bracts membranous, white, ovate-acuminate. Bractioles ovate-lanceolate. Tepals sub-equal, oblong-lanceolate, prominently 3-nerved, pilose in the lower half. Stamens 5, fertile; staminodes subulate. Ovary compressed-globose. Style stout. Utricle orbicular. Seeds brownish.

**Fls. & Frts. :** Oct.-Feb.

Koraput, 8020.

***Cuscuta chinensis*** Lam. Encycl. 2: 229. 1786; Matthew, Fl. Tam. 2: 1013. 1983; Haines, Bot. Bihar and Orissa 2: 635. 1961.

Stems filiform, twining, leafless. Flowers axillary solitary or in fascicles. Calyx lobes 5, scarious, ovate. Corolla lobes 5, cream coloured, campanulate, scales fimbriate. Stamens 4, filaments short. Ovary 2-celled, styles 2. Capsule globose.

**Fl. & Frts.:** Nov.-Feb.

Koraput, 8042.

**Note:** This species has not been reported within the geographical boundary of Orissa.

***Justicia vahlii*** Roth, Nov. Pl. Sp. 14, 1821; Gamble, Fl. Pres. Madras 757. 1957.

***Jisticia diffusa*** var. ***vahlii*** Clarke in Hook. f. Fl. Brit. Ind. 4: 538. 1885; Haines, Bot. Bihar and Orissa 2: 727. 1961 (Repn. Ed.).

Erect or procumbent herbs. Stems tetragonous, grooved, scabrid. Leaves lanceolate or linear. Bracts linear-lanceolate. Spikes, dense terminal. Corolla pink, 2 lipped. Stamens 2. Capsules oblong, grooved.

**Fl. & Frts.:** Oct.-Jan.

Koraput, 8022.

**Note:** This taxon has been collected from Chhotanagpur by Clarke.

***Lindernia multiflora*** (Roxb.) Mukerjee, Journ. Ind. Bot. Soc. 24: 131. 1945; Babu, Herbaceous. Fl. Dehradun 355. 1977. *Torenia multiflora* Roxb. Fl. Ind. (ed. carly) 3: 96. 1832. *Vandellia multiflora* (Roxb.) G. Don, Gen. Syst. 4: 549. 1838; Haines, Bot. Bihar & Orissa 2: 662. 1961.

Erect caespitose herbs. Stems angled, fleshy. Leaves sessile, elliptic-ovate. Flowers in terminal recemes. Bracts minute. Calyx lobes 5, lanceolate, thinly hairy. Corolla lobes 5, bilipped, white, purple throat. Stamens 2, staminodes 2, bristly. Stigmas 2, spathulate, ovary 2-celled, capsule ellipsoid slightly longer than calyx.

**Fls & Frts.:** Dec.-Jan.

Koraput, 6726.

**Note:** This species has been collected from Bihar by Haines.



## ACKNOWLEDGEMENT

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### 39. RECOLLECTION OF AN ENDEMIC MONOTYPIC SIKKIMESE GENUS *CYATHOPUS* STAPF (GRAMINEAE) AFTER FIFTY YEARS

(With a text-figure)

## INTRODUCTION

Stapf (1895) validated the genus *Cyathopus* by describing the single species *C. sikkimensis*, based on the single collection of J.D. Hooker from Lachoong Valley, North Sikkim. After that the species has been collected but once by N.L. Bor's collector in 1943 at an altitude of c.1825 m from Sikkim. But there is no detail about the exact place of collection on the herbarium sheet deposited in DD as well as in the literature (Bor 1960).

During the last fifty years numerous plant exploration teams from various Indian as well as foreign research institutes and universities, have conducted tours in various parts of Sikkim including the type locality of this genus. But so far no further information is available about the occurrence of this genus from any part of this region (Rao 1964, Hara 1967, 1971, Sharma and Ghosh 1971, Ohashi 1975, Hara *et al.* 1978, Subramaniam 1973, etc).

Moreover, Ved Prakash and Jain (1979) have also based revision of the genus *Cyathopus* on the photograph of the type collection (original specimen at Kew) and Bor's collection deposited in Herbarium of Forest Research Institute, Dehradun (DD). Since 1990 I have

been actively engaged in the systematic study of grasses of Sikkim. As a part of this continuing endeavour the plants of this extremely rare, threatened and endemic grass genus were located near Kyanglasha on way to Tsmango lake in east Sikkim. As the present collection has been made after a lapse of about fifty years and from a new locality, this communication reports it with a description of the genus and species along with analytical figures and notes.

## SYSTEMATIC POSITION OF THE GENUS

*Cyathopus* with its lax panicle and 1-flowered spikelets was placed under the tribe Agrostidae by Hooker (1896). It was kept under the tribe Garnotieae by Bor (1960) and Ved Prakash and Jain (1976). However, *Cyathopus* and *Garnotia* which were thought to be closely related by Bor (1960) and others, differ in quite a few characters. *Cyathopus* has a long membranous ligule, entire membranous lemma without awn (ligule fringed with hairs, lemma cartilaginous, bidentate at apex with geniculate awn in *Garnotia*).

Recently Clayton and Renvoize (1986) have placed the genus under the tribe Avenae-subtribe Alopecurinae and consider it closely related to



*Enthryptochloa* Cope, *Cinna* L. and *Agrostis* L.

### **Cyathopus Stapf**

*Cyathopus* Stapf in Hook. Ic. Pl. t. 2395. 1895; Hook. f. Fl. Brit. India 7: 240. 1896; Bor, Grasses Ind. 565. 1960; Ved Prakash & Jain in Fasc. Fl. India 3: 2. 1979; Clayton & Renvoize, Genera Gram. 140. 1986.

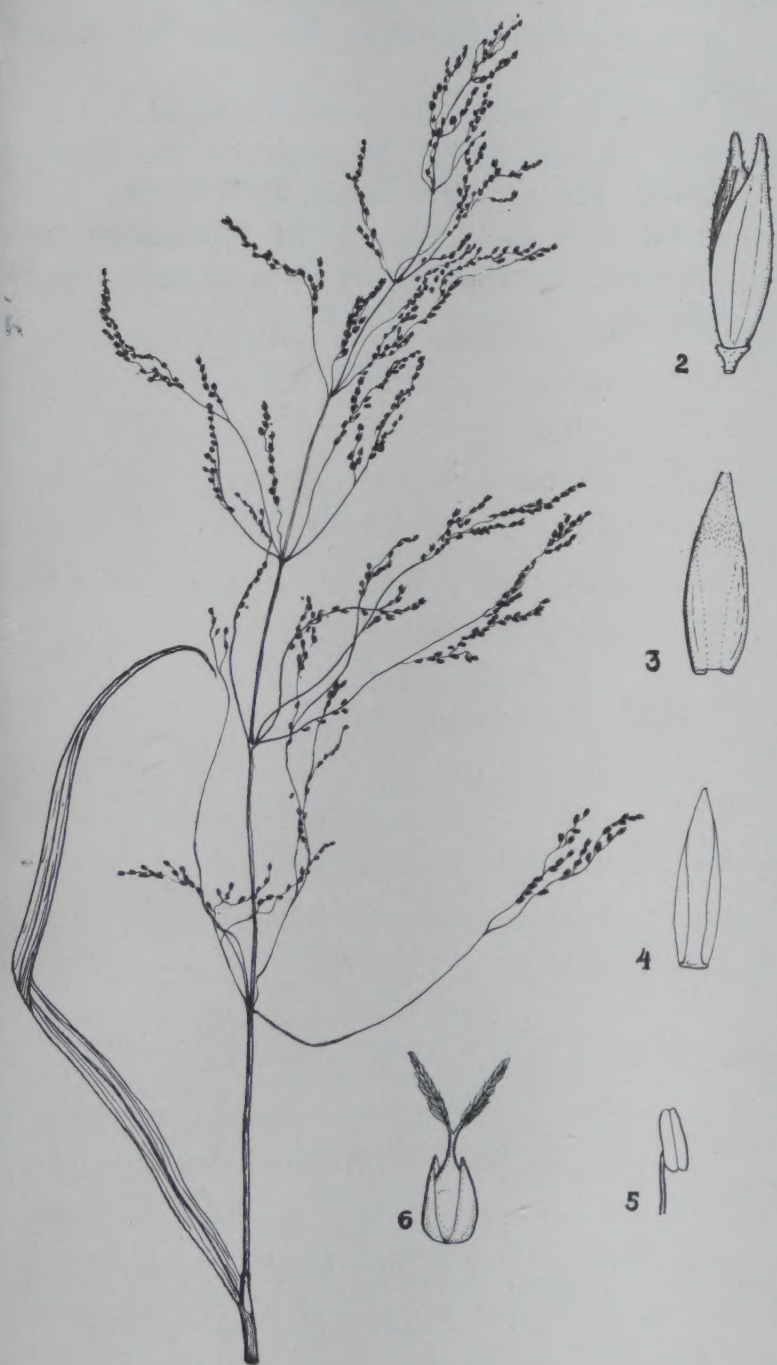


Fig. 1. *Cyathopus sikkimensis* Stapf

1. A part of the plant with inflorescence; 2. Spikelet; 3. Lemma; 4. Palea; 5. Stamen; 6. Gynoecium with lodicules.

Perennial, culms slender, terete, branched, glabrous, ascending; leaf-blades flat. Spikelets on slender branches of decompound panicles, 1-flowered, subterete, awnless with glabrous base, without rachilla extension, falling entire; glumes equal, slightly exceeding the floret, strongly 3-nerved, lanceolate, beaked, lemma lanceolate, obtuse, membranous, 5-nerved, awnless, smooth, ovary glabrous. Caryopsis ovate-elliptic.

A monotypic genus endemic in Sikkim.

*Cyathopus sikkimensis* Stapf in Hook. Ic. Pl. t. 2395. 1895; Hook. f. Fl. Brit. India 7: 240. 1896; Bor, Grasses Ind. 565. 1960; Ved Prakash & Jain in Fasc. Fl. India 3: 2. 1979.

Culms c. 1 m high, ascending from a creeping stoloniferous base. Leaf-sheaths deeply striate, glabrous; ligule elongate, scarious; leaf-blades 15-25 x 0.6-1 cm, linear-lanceolate, finely acuminate, glabrous, margins scaberulous, panicle 20-35 cm long, scaberulous. Spikelets c. 2 mm long, green, pedicels 1-3 mm long. Glumes c. 2 mm long, scabrid on the nerves. Lemma 2-2.4 mm long. Palea c. 2 mm long. Caryopsis c. 2 mm long; hilum basal, punctiform.

**Fl. & Fr.:** September-December.

**Distribution:** SIKKIM: North Dist., Lachoong valley; East Dist.; Near Kyanglasha. Between 1830-3660 m altitude.

**Specimens examined:** SIKKIM: without precise locality, 1830 m Nov.-Dec. 1943, Bor's collector- 330 (DD); East District, Near Kyanglasha on way to Tsamngo, c. 3350 m, 14 Sept. 1992. P. Singh- 13831 (BSHC).

**Notes:** So far this species has been known from only one locality in North Sikkim. The collection of the *Cyathopus sikkimensis* from East Sikkim revealed the present habitat of this species. Only a few plants were observed straggling amongst the bushes of *Rhododendrons* and *Potentillas*. Initially it appeared like an *Agrostis* species but the presence of beaked



glumes facilitated its identification as *Cyathopus sikkimensis*. This character becomes more prominent in dried specimens.

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